



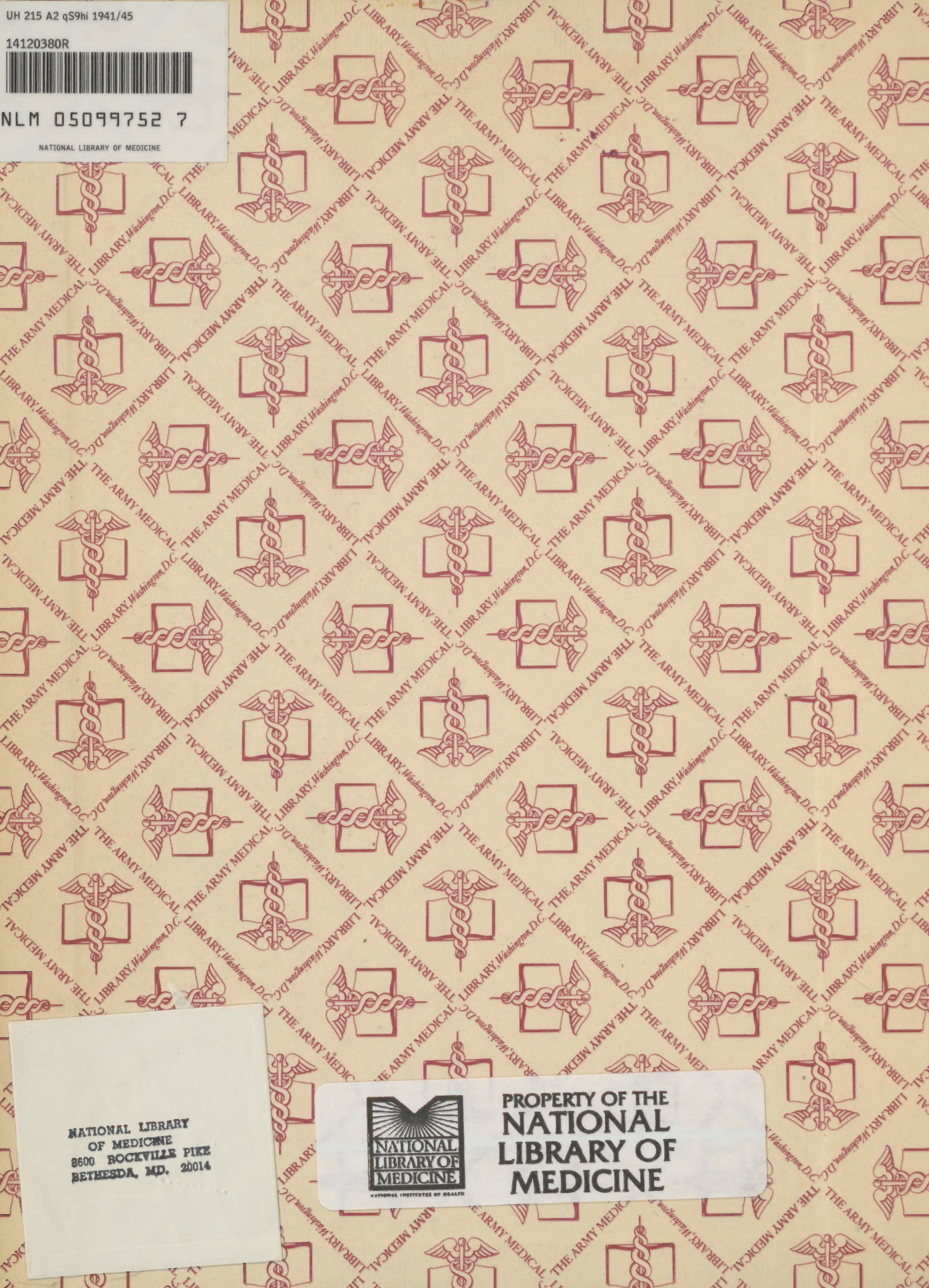


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A HISTORY OF PREVENTIVE MEDICINE

IN THE

EUROPEAN THEATER OF OPERATIONS

UNITED STATES ARMY

1941 - 1945

VOLUME I

by

Colonel John E. Gordon, M.C.  
Chief of the Division of Preventive Medicine  
Office of the Chief Surgeon, ETO

This monograph is being made available in manuscript form pending the completion of the official History of the Medical Department in World War II, and must be considered as a draft subject to final editing and revision. Persons finding errors in facts or important omissions should communicate with the Historical Division, Army Medical Library, Washington 25, D.C.

It is emphasized that all statistical data in this monograph are tentative and subject to revision when tabulation of individual sick and wounded report cards has been completed.

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7 16 Sept 1948

## FOREWORD

This History of Preventive Medicine in the European Theater of Operations has had the advantage of being written in large part by the men who did the things that are described. The four principal parts of the program in Preventive Medicine were in epidemiology, nutrition, venereal disease control and sanitation.

The Chiefs of those branches during operations in Europe subsequently served on temporary duty with the Historical Division of the Office of The Surgeon General where this history was written. The section on nutrition is wholly the contribution of Colonel Wendell H. Griffith. Lt. Colonel Paul Padget wrote the section on the control of the venereal diseases, and Lt. Colonel Ralph R. Cleland that on sanitation. They brought to the presentation an authority and a familiarity with detail and policy not possible in a history compiled from records by the most capable of historians. The section on epidemiology was contributed by the Chief of the Division of Preventive Medicine, who by reason of personal interest and often of necessity, was the continuing director of activities in that field.

The remaining chapters on administrative and technical features of the work in Preventive Medicine were likewise written by the chief of the division. The thorough documentation and illustration of events by pictures, charts, tables and epidemiological case reports was done by Captain Edna M. Cree, who in her long association with the Division of Preventive Medicine had the foresight to accumulate material and effect analyses which could not have been accomplished in retrospect.





## BIBLIOGRAPHICAL NOTE\*

The major source of the material in Part XI, aside from the personal observation of the author, is the Diary of the Division of Preventive Medicine, Office of the Chief Surgeon, European Theater of Operations, (300.6). Also consulted were Annual Reports of the Division, 1942-44, inclusive, and its Periodic Report, Jan-Jun 1945, (both in 319.1-2). With regard to the relationships of the Preventive Medicine Division and the Professional Services Division in the theater, see William S. Middleton, "Medicine in the European Theater of Operations," Annals of Internal Medicine XXVI (February 1947) 191-200 and Annual Reports of the Division of Professional Services, Office of the Chief Surgeon, European Theater of Operations, for 1943 and 1944 (319.1-2). Cooperative activities in the field of preventive medicine for civilians are reported in monthly statements submitted by the Preventive Medicine Division to Civil Affairs Branch, Operations Division, Office of the Chief Surgeon, European Theater of Operations, Jun-Oct 1944, (014 (Reports, Civil Affairs, Prev. Med. Division)). Illustrations of the relationship between the Preventive Medicine Division and the United States Public Health Service are provided in "Ltr., SGO (Prev. Med.) to Chief Surgeon, ETO (Prev. Med.), 31 Dec 1942, Sub: [Introduction of Dr. Hamilton Southworth]" (729 (Medical Intelligence Section Correspondence)) and "Ltr., National Institute of Public Health, to Chief Surgeon, ETO (Gordon), 9 November 1942, Sub: [Work of Dr. Mooser upon typhus vaccines]" (710-(Typhus Immunization)). Correspondence (Sept-Dec 1942) covering various aspects of British-American liaison in the field of preventive medicine is filed in 337 (British-OCS Liaison). For the relations of Dr. John E. Gordon with the British Ministry of Health in the period prior to the entrance of the United States into the war, see The American Red Cross Harvard Field Hospital Unit (Cambridge, Mass., 1943). Among the sources for the cooperation of British agencies with the Preventive Medicine Division in the field of research are Annual Report, Medical Department Activities, Eighth Air Force in Europe, 1943, and History of the 1st General Medical Laboratory (both in 319.1-2). Cooperative activities with British military and civilian organizations in the handling of venereal disease are documented in correspondence and minutes of meetings filed in 337 (Conferences-Command Venereologists), Oct 1942 - Apr 1943, and 080 (Medical Society for Control of Venereal Diseases), Dec

1942 - Feb 1944. The relations between the preventive medicine service and the American Red Cross are covered in correspondence, Jul 1942 - Jun 1945, of the Office of the Chief Surgeon, with and concerning that body, on file in 080 (Red Cross). See particularly "Synopsis of Ltr., Chief Surg., ETO, to Liaison Officer with the American Red Cross in Great Britain, 17 March 1943, Sub: Letter of Instructions." A copy of "Sanitary Code for American Red Cross Service Clubs"---Club Department Circular No. 2, 8 November 1943, is on file together with related correspondence in 080 (Red Cross Miscellaneous Information).

Attention also is called to the other sections of this work, particularly, Part V - Venereal Disease Control, wherein more detailed discussions of cooperative activities in individual fields of preventive medicine appear.

\*All file numbers mentioned in this note refer to materials in the ETO files, Historical Division, Army Medical Library.



A HISTORY OF PREVENTIVE MEDICINE  
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Part I - The Progression of Events  
in Preventive Medicine, ETO

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## PART I

### The Progression of Events in Preventive Medicine, ETO

American interest and effort in military preventive medicine in the European war zone originated long before the European Theater of Operations came into being, and indeed measurably before war was declared by the United States. On the military side, this was a logical development of the long-term planning of the Office of The Surgeon General, United States Army. As the probability of war became increasingly evident, civilian authorities in preventive medicine and public health organizations in America gave increasing attention to the necessary correlation of civilian and military effort; and to the means by which civilian staffs, equipment, and experience could be converted to a war-time military organization.

Beginning shortly after war broke out in Europe in September of 1939, various groups of American observers visited The United Kingdom to gain first hand knowledge of health conditions. After America declared war on 7 December 1941, and as the numbers of United States troops coming to the United Kingdom became greater and greater, the degree of attention devoted to the preventive aspects of medical practice increased progressively. The medical service of the Army began to take shape, and officers were assigned specifically to duty in preventive medicine. Eventually a regularly constituted Division of Preventive Medicine was established in the Office of the Chief Surgeon, European Theater of Operations, 26 August 1942.

Initial American Activities in Wartime Preventive Medicine in Europe, 1940. Representatives of the Bureau of Medicine and Surgery of the United States Navy were among the first American medical men to arrive in the United Kingdom for observation of medical features of the war. Lieutenant Commander Irwin L. V. Norman and Lieutenant (j.g.) Simon B. Eyer established headquarters and were attached to the

American Embassy in July 1940. They collected information about current medical practices and problems, and brought together factual data relating to military medicine, much of which was in the field of preventive medicine. This material was forward to the United States for general use by civilian and military agencies concerned with preventive medicine and public health.

At the invitation of the British Ministry of Health, the National American Red Cross and Harvard University joined in establishing the American Red Cross--Harvard Field Hospital Unit to work throughout the British Isles in preventive medicine and epidemiology. Headquarters were established in London during late July 1940. Subsequently, in 1941, the base of operations was transferred to Salisbury, Wiltshire. Provision had been made in this city of southwest England for a 100 bed hospital for study and observation of communicable disease; for a well-equipped laboratory; and additionally a group of epidemiological workers to conduct field studies of epidemic disease in civilian and military populations. The director of the unit, Dr. John E. Gordon, Professor of Preventive Medicine and Epidemiology at Harvard University, was also attached to the Ministry of Health as liaison officer, charged with the responsibility of collecting and transmitting medical information of military interest to British and American public health authorities.

European Activities of the United States  
Army before 7 December 1941.--In April of 1941, Colonel (then Major) A. B. Welsh of the U.S. Army Medical Corps arrived in London to be attached to the United States Embassy, and to establish an office related to Army medical affairs. He was one of a group of officers and men from many arms and branches known as the Special Observers Group. They had headquarters at 20 Grosvenor Square in London, and comprised expert observers whose general responsibility was to serve the best interests of the United States, as a nation technically at peace but nevertheless vitally concerned in the war effort of the United Nations. These observers kept the War Department informed and prepared the way



for prompt action once war was declared.

The principal interest of Major Welsh was in the collection of available information on the medical facilities of Iceland, this being incident to the plans then under way for American occupation of that island. With the assistance of officers of the Ministry of Health, of the British Colonial Office and of Dr. John Gordon of the American Red Cross, several weeks were devoted to assembling information about Iceland, in relation to communicable diseases, water and food supply, sanitation, provision of medical care, available hospital beds, general health conditions and a wide variety of other affairs, many of which had a direct relation to preventive medicine.

In the early summer of 1941, a similar survey was made of health conditions in West Africa, including Gambia, Sierra Leone, Liberia and French West Africa. It is evident that much of Major Welsh's time was devoted to medical intelligence, an active field in preventive medicine.

Colonel (later Major General) Paul R. Hawley succeeded Major Welsh on 22 September 1941. He set up offices in Flat 14, 20 Grosvenor Square, and began to build the firm foundation of the future Office of the Chief Surgeon, ETO, at Headquarters Special Observers Group. Because of his training in public health and his long experience in preventive medicine, those interests entered prominently into the work of his office.

Preventive Medicine in United States Army Forces, British Isles.--With declaration of war by the United States on 7 December 1941, the work of the medical department of the United States Army took on many new interests and experienced greatly enhanced activity. Nevertheless, Colonel Hawley continued for some time to be a one-man medical department. On 7 January 1942, 1st Lieutenant Dean S. Fleming, a member of the Medical Officers Reserve Corps, was called to active duty from the Harvard Field Hospital Unit, to be the first assistant attached to Colonel Hawley's office. Lieutenant Fleming had been trained in public health and had already had some seven months experience in war-time preventive medicine in England. In his new capacity, he

initiated policies and made plans for work in preventive medicine in what was to be the future European Theater of Operations.

Early in January of 1942, the United States Army established itself as the United States Army Forces in the British Isles (USAFBI). The medical section of the Special Observers Group became part of the headquarters of this force. On 10 March 1942, the section became known as the Office of the Chief Surgeon, USAFBI, with a staff of four officers and a separation of interests which included assignment of 1st Lieutenant Fleming to affairs concerned with preventive medicine, personnel matters, physical standards, and medical reports. This constituted the first official recognition of preventive medicine as one of the primary functions of the Medical Department under field conditions in Europe.

The program in preventive medicine developed gradually and informally. In January much time was spent in liaison work with the Royal Army Medical Corps and with British civilian health authorities, principally the Ministry of Health. The first large contingent of American troops arrived in North Ireland 26 January 1942. Early in February, Lt. Fleming made an inspection of housing conditions and general sanitary provisions in the Ulster region. Activities of early March included a survey of insect pests in North Ireland with recommendations for their control. During the subsequent spring months, some few cases of epidemic meningitis occurred among troops in North Ireland, incident to a moderate general prevalence of this communicable disease in the British Isles. By April, the first sanitary reports from American military organizations were received at the Office of The Chief Surgeon; and measures were taken for their review and for action on the recommendations they contained.

An organization gradually took form at USAFBI Headquarters for adequate attention to affairs concerned with preventive medicine. The Army still lacked the technical help which enters so pertinently into a program for prevention of communicable disease, and for provision of an adequate health service. No laboratory facilities were available, nor were there trained field



investigators. The sponsors of the American Red Cross-- Harvard Field Hospital Unit had directed, however, that the facilities of this organization be placed at the disposal of the United States Army, a policy endorsed by the British Ministry of Health under whom the unit was working. After mature consideration, it was agreed that for the present, the Harvard Unit had best maintain its civilian status with the unit contributing voluntary technical assistance to the army in epidemiology and preventive medicine. At this early date, however, it was appreciated that the full facilities of the unit would eventually be required by the Army; and the decision was taken that ultimately it would be incorporated into the Medical Department of the United States Army. Under this arrangement the Harvard Unit contributed technical advice and help to the Office of The Chief Surgeon during the next several months.

The most important professional activity in preventive medicine during this first year of the theater's existence was in relation to an extensive outbreak of homologous serum jaundice in May, 1942. Occurring first among troops stationed in North Ireland, it subsequently involved a number of units arriving in Great Britain. The cause was promptly determined to lie in the administration of yellow fever vaccine and to be concerned primarily with an icterogenic agent present in the supposedly normal human serum used in preparation of the product.\* Several members of the Harvard Field Hospital Unit were engaged in the control and management of this outbreak, including the entire epidemiological staff, a group of four public health nurses, and the facilities of the laboratory. They cooperated closely with the staff of the 5th General Hospital, then located near Belfast, Ireland, where most of the patients were in hospital. Furthermore, a number of the hospital staff participated in field studies which extended through most of the units then stationed in North Ireland.

\*Although the cause of this outbreak of jaundice was already known in the United States, such information had not yet reached U.S. Forces in Great Britain, where the cause was ascertained independently.

The increasing activities in preventive medicine were, of course, only a part of the general development at this time within the Office of the Chief Surgeon. The program expanded to such an extent that it became necessary to have more space for the medical section. Accordingly, on 7 May 1942, the Office of The Chief Surgeon moved to the second floor of an apartment building at 9 North Audley Street, London, where twelve rooms became available. The office organization as of 15 May 1942, included a division responsible solely for preventive medicine, and under the direction of 1st Lieutenant D. S. Fleming.

The gradual expansion of other arms and services of the Army and the increasing number of troops arriving in the theater, presented greater demands on the Division of Preventive Medicine and defined the need for its own technical organization and staff. As a consequence, Colonel Hawley decided in the later part of May to activate the American Red Cross--Harvard Field Hospital Unit as Medical General Laboratory A, to become an integral part of the Medical Department and to be responsible to the Division of Preventive Medicine in the Office of the Chief Surgeon. As a part of this plan, Dr. John E. Gordon, director of the unit, was to accept commission in the Army of the United States, and to become chief of the Division of Preventive Medicine. The tentative date of 15 July 1942 was set as the time for transfer of the unit facilities.

The ETO and Preventive Medicine--June 1942.  
The progressively expanding organization known as the Office of The Chief Surgeon, USAFBI, was now the top ranking medical headquarters in the theater, and was charged with the coordination of all United States Army Medical Department activities in the British Isles. On 8 June 1942, the USAFBI was terminated through process of conversion into the European Theater of Operations, United States Army (ETOUSA). United States Army forces in Iceland were included in the new organization.

With the increasing responsibilities which came with the arrival of more and more troops, the work of the Division of Preventive Medicine was greatly extended. Prominent among interests at this time were the housing of troops, mess sanitation, and the general



problem of nutrition. As the scope of duties in preventive medicine became better defined, plans were made for an augmented staff. A request was made to the War Department for assignment of a venereal disease specialist, a nutritionist, and a sanitary engineer.

The increasing complexity of the ETO led to a basic reorganization of United States Army forces in the theater. A Ground Force, an Air Force and the Services of Supply were established. They began to operate in clearing up the confusion arising from the presence in England of many advanced echelons of all arms and branches, now landing almost daily. The several supply and technical services of the Army were assigned to the Services of Supply, an arrangement which gave them a definite organization and a channel of authority, and on 18 June 1942 the Office of The Chief Surgeon was relieved of assignment to Headquarters ETOUSA and reassigned to Headquarters, Services of Supply. Thereafter, the Office of The Chief Surgeon functioned as a part of this newly-established headquarters, although maintaining through the dual function of The Chief Surgeon in both Services of Supply and in the Theater, an overall interest and authority in supervision of activities in preventive medicine for all troops of the command.

On 7 July 1942, Dr. John E. Gordon was commissioned in the Medical Corps and became the Chief of the Preventive Medicine Division. On 23 July 1942, the office of the Chief Surgeon moved to the newly established headquarters of the Services of Supply at Benhall Farm, Cheltenham, Gloucestershire. The staff of the Division of Preventive Medicine then included Lt. Colonel John E. Gordon, Major John W. R. Norton, Major Emory C. Cushing and 1st Lieutenant D. S. Fleming. The first two enlisted men joined the staff.

Preventive Medicine under SOS, ETOUSA.—An actively functioning and organized effort in preventive medicine can be said to date from about this time, mid-summer of 1942.

The plan of organization for the Division of Preventive Medicine provided for five principal branches dealing, respectively, with epidemiology, sanitation, nutrition, medical intelligence, and laboratories. A

memorandum of the Office of The Chief Surgeon dated 26 August 1942 formally activated the division and defined its duties, to include intelligence relating to communicable diseases, nutrition, supervision of the central laboratory, sanitation of camps and billets, sanitary inspections and reports, and liaison with British agencies in preventive medicine.

Problems associated with nutrition had entered prominently into the activities in preventive medicine from the beginning. Organized effort dates from the arrival of Major (later Colonel) Wendell H. Griffith on 4 September 1942 to become chief of that branch.

With the arrival of Major (later Lt. Colonel) Paul Padget, M.C., a venereal disease control branch was added to the preventive medicine division as of 26 September 1942. Its duties were limited to the preventive aspects of the venereal diseases. Matters pertaining to the care of patients remained a function of the Division of Professional Services.

As would normally be anticipated, the development of this new theater of operations was associated with many problems relating to environmental hygiene. Affairs of sanitation were a general function of the division until the work was organized as a special branch under an experienced sanitary engineer, Lt. Colonel Ralph E. Sweeney, SnC., who reported for duty on 12 October 1942. Colonel Sweeney's association with the Division of Preventive Medicine was short-lived, because of the need for assigning him to other duties in the North African Theater. He was succeeded on 29 October 1942 by Major (later Lt. Colonel) Ralph R. Cleland, SnC, a sanitary engineer with appreciable experience in Great Britain through his preceding connection with the Hospitalization Division.

The Epidemiology Branch during the early days was under the direction of Major (later Lt. Colonel) J. W. R. Norton. He was the first of the staff to be transferred on 15 September 1942 to Allied Forces Headquarters for duty in preventive medicine in the coming African campaign. Thereafter and for the next year or more, primary direction of epidemiological affairs was an obligation of the chief of the division.



Laboratory Service Established.---On 15 July 1942, the former Harvard Field Hospital Unit became Medical General Laboratory A, (prov.) closely associated with the Division of Preventive Medicine and furnishing technical aid to it. In the course of the next six weeks, plans were made to enlarge the original laboratory plant to a size sufficient to provide adequate central laboratory service for a theater of operations. Laboratory supplies and equipment were obtained to match this expansion. Authorization was obtained for the necessary increase in laboratory staff to bring Medical General Laboratory A to a strength approximating that of a general laboratory. After an initial three months of temporary arrangements, the unit came under the permanent command of Major (later Colonel) Ralph S. Muckensuffss, MC., who developed a comprehensive and efficient laboratory service.

Early Activities, 1942.---The first year of the Division of Preventive Medicine falls into three rather well-defined phases. In the beginning, the work in preventive medicine was organized on a very general basis, with the varied activities shared by the limited staff.

There followed then a second stage of development in which the several features of work in preventive medicine, such as epidemiology, nutrition, venereal disease control and sanitation became centered about a qualified expert who took more or less complete responsibility for his particular specialty.

During the autumn months of 1942, the time of staff members in preventive medicine was directed in large part toward two principal objectives. The first was in aid of mounting Operation TORCH, destined for assault on North Africa. The second was to assure satisfactory sanitary provisions for newly arrived troops, scattered widely throughout southern England. ✓

Units representing most of the arms and branches of the Army were arriving almost daily in Great Britain. (Fig. 1) They moved into unorganized camps or into old quarters vacated by the British Army. They were uniformly unfamiliar with living and sanitary conditions in this new country in which they found themselves. There was loose coordination with secondary



echelons of command. Units were commonly unfamiliar with theater directives. It was therefore decided that a team of experienced experts in sanitation should visit all camps and installations of the theater, to bring definitive advice and information on sanitary procedures and to aid units in their own immediate and particular problems. Actually, this project was illustrative of a policy which was to guide all future operations in preventive medicine in the European Theater--an appreciation of the continuing necessity for active field work; the need to carry preventive medicine policies and methods directly to those who were to use and apply them. It gave headquarters an appreciation of problems in the field not otherwise possible. For the individual unit, help was furnished of a kind which cannot be brought about through directives or formal recommendations, nor accomplished by requisitions.

The officers engaged in this work found an enthusiastic reception by medical officers of individual units. They provided the intimate and practical information most needed at this time. It was not unusual to find camps and military organizations not noted on any station list. This activity was started on 29 August 1942, and continued until February 1943, during which time United States military installations of the south, the west and the east of England were visited in turn.

The mounting of Operation TORCH began in early September, continued through October, and was completed in November. Three members of the limited staff in preventive medicine were furnished to this project. The specific plans for the operation in respect to preventive medicine were developed almost wholly by Major Norton at Headquarters, Allied Forces. In the course of the autumn, however, numerous conferences were held with surgeons of units designated for the operation, numerous inspections were made of alerted organizations, and advice and aid were given on many special interests in preventive medicine. In the final analysis, the mounting of this operation was decidedly makeshift, compared with the major effort which went into preparations for the subsequent landing in Normandy. When TORCH task force finally left England, the theater that remained had much the appearance of a plucked fowl, since staff and equipment had been contributed most freely to the organization of this essential military effort. Thereafter, the theater settled down to the work of the day, with scant idea of what the future held forth.



Figure 1.

Men of the infantry pack the rails of a tender bringing them to British shores from their convoy, 1942.





Later Activities, 1942 - 1943.--The strength of the command and the number of camps and installations had, however, increased to such extent by the latter days of 1942, that general administrative procedure in the Services of Supply was decentralized into five base sections. In accordance with this general policy, work in preventive medicine underwent a similar decentralization. This marked the third general phase into which activities for 1942 were separated. Under this arrangement, each base section had its own division of preventive medicine. The typical unit consisted of an epidemiologist, a venereal disease control officer, a nutrition officer, and a sanitary engineer. Because of limited personnel, the plan scarcely got under way in 1942, but came to full realization in the early months of 1943. As qualified officers became available, practice in preventive medicine thus changed from a responsibility vested in a centralized program, to a decentralized system with primary operational responsibility a function of base sections. The Division of Preventive Medicine at theater headquarters became essentially a supervisory group, although as an integral part of the Services of Supply, its relations to the several base sections were close, continuing and inclusive.

During the first half of 1943, the lack of precise and permanent decision about the place that the European Theater of Operations was to occupy in the world tactical plan, served to inhibit straight-line planning in theater activities. There was decision for rapid and extensive build-up in troop strength. It was countermanded. Again came directions for augmented activities and increased manpower, and again progress slowed down. Not until early summer of 1943, was a policy definitely formulated for an ultimate assault on the west coast of Europe and an invasion of France. Thereafter the concerted effort of all parts of the service was directed to that end.

In respect to preventive medicine, the early period of 1943 was devoted to building up a strong and integrated program for the future base of operations in the United Kingdom. As the year progressed, new troops arrived in continually increasing numbers, not only from America but from Iceland, from the North African Theater of Operations, and by plane over the south Atlantic route.



This served to introduce new problems in preventive medicine, including those of tropical and subtropical climate. When the year 1943 ended, activities in preventive medicine had broadened both in scope and in kind, incident to the more than five-fold increase in theater strength.

Of the professional problems presented during this period, perhaps the most outstanding was an epidemic of influenza in October, November and December of 1943. Although the attack rate was substantial, the clinical form of the disease was relatively mild and no deaths directly attributable to this cause occurred among American soldiers.

Epidemic hepatitis had been an infection of fairly frequent occurrence in the British population throughout the war years. It spread to United States troops. The small outbreaks which had been of frequent report for a year or more, increased perceptibly when American troops from Africa arrived in the autumn of 1943. The disease had been unusually prevalent there. Attack rates continued high until the usual seasonal influence led to improved conditions in the summer of 1944.

Malaria, a disease of such rarity in Great Britain as to be almost a curiosity, became one of the more important health problems as troops seeded with this infection returned from Africa, Italy, and particularly Sicily. They frequently experienced relapse or recurrence of previous clinical manifestations, and sometimes developed primary clinical attack after previous suppressive action of atabrin. The number of cases reported during late 1943 and early 1944 was of such magnitude as to require special measures to prepare these troops for continental operations.

The increasing importance of planning operations for the Normandy invasion made necessary the return of the Office of The Chief Surgeon to the old quarters in North Audley Street, London. After establishment there, on 7 February 1944, all other activities of the Division of Preventive Medicine were submerged in the primary objective of assuring satisfactory preparation for this major military objective.

Preventive Medicine in 1944.---As 1944 came into being, the situation in preventive medicine in respect to administrative practice, was essentially the following. The Division of Preventive Medicine in the Office of The Chief Surgeon, ETO, exercised an overall theater supervisory function. This relationship, in respect to general medical organization--and thereby including preventive medicine--had been clarified and redefined by administrative order of the Commanding General, ETO, early in January. The Ground Forces through all major echelons had well-organized staffs for preventive medicine. The Air Forces had a solid comprehensive program. Base section organization had reached full fruition, with adequate staffs in all principal units of the Services of Supply.

Actual plans in preventive medicine for the Operation OVERLORD were developed at theater headquarters, but throughout the period of constructive effort, which extended through the first five months of 1944, the closest cooperation was practiced with those units of the three major services primarily concerned.

Preventive Medicine in the Ground Forces.---Until late in 1943, the number of Ground Force troops in the European Theater was relatively small. Divisions and the single existing corps had the usual provisions for preventive medicine, under direction of appropriate medical inspectors. The First U.S. Army was established late in 1943, principally from troops returned to Great Britain, from Africa and Sicily. In the spring of 1944, Third Army Headquarters was established in northern England. In the subsequent organization and training of these forces, close cooperation developed in matters concerned with preventive medicine, between the staffs of base sections in which ground forces were located, and with the several branches of the Division of Preventive Medicine in the Office of The Chief Surgeon. Both Armies had well-organized divisions of preventive medicine, that of the First Army under Lt. Colonel Edward S. Murphy, and that of the Third under Major W. P. Killingsworth.



Preventive Medicine in the Air Forces.--From the date of its activation, the Eighth Air Force had a firmly conceived program of preventive medicine, a circumstance which arose largely from the strong personal interest of the Surgeon in that field of medical practice. Special stress was placed on the personal health problems of the individual flyer. Outstanding accomplishments included the production of protective body armour and useful improvements in types of clothing and personal equipment.

In matters of interrelated theater interest there was much common effort among preventive medicine officers of the Air Force and those at theater level. Programs in nutrition and in venereal disease control in the Air Forces were integrated with those of the theater. Measures for the control of the communicable diseases were necessarily of mutual concern and interest, prominent among which was a long continued cooperation leading to promulgation of improved regulations for the sanitary control of airports and of air traffic. Much dependence was placed on staffs in sanitary engineering at base sections, with the base sections exercising essentially area control in matters of water supply and waste disposal.

Nevertheless, contacts were less close, and common interests were fewer between the Air Force and other preventive medicine services of the theater--both at base section and at theater level--than with the Ground Forces. This was true for a variety of reasons. The Air Forces had greater independence and identity of medical organization, compared with the Services of Supply and the Ground Forces. A smoothly functioning program in preventive medicine suited to the needs of the Air Force was established at an early date. Finally, many of the problems were peculiar to the Air Forces, such as those related to the physiological hygiene of flying.

Preventive Medicine and Civil Affairs.--In preparation for the future invasion of the continent, a general staff section of theater and Army headquarters to deal with civil affairs, G-5, was set up in late 1943. Its activities increased measurably in 1944, so that by June a comprehensive organization had been effected to cope with civilian affairs in liberated

territory, and to establish military government in occupied enemy areas. One of the principle subdivisions within the civil affairs staff section was that concerned with public health and welfare. This particular activity was represented both at theater headquarters and in civil affairs G-5 sections of Armies. As preparations for the invasion became more nearly consummated, numerous conferences and consultations were held to coordinate public health activities among civilian populations with preventive medicine interests of the army. Cooperation was particularly close with the public health sections of civil affairs divisions in the two armies that were preparing for the invasion.

#### Marshalling and Mounting of Operation

OVERLORD. --A comprehensive plan in preventive medicine for Operation OVERLORD, the invasion of Normandy, was completed early in 1944. Individual contributions by the several technical specialists at headquarters were worked into an inclusive and unified plan. (Appendix A, Part 1). This formed the basis and furnished the material for the final mounting plans of the general operation itself, and that of the Communications Zone. These two documents were known as Mounting Plan Medical Corps, Annex Number 8, Section 5; and the Medical Plan, Annex 9, Sections 7 and 8, Communications Zone. They dealt with essentials in simple terms, for example the introductory statement: "Proper sanitation is a command responsibility", --no more, no less. Individual directions were given on matters concerned with food, water, waste disposal, the control of respiratory, intestinal and venereal diseases, for the management of insects and rodents, immunization and for general hygienic requirements.

In preparation for the operation, a program of re-immunization against certain specific infectious diseases was instituted in February, 1944. In March, field surveys of various ground and air force units gave assurance that troops to be involved in the operation were almost without exception satisfactorily protected against typhoid, smallpox, typhus fever and tetanus.

Reports through medical intelligence channels had established the presence of typhus fever in German



concentration and forced labor camps in France since as early as 1943. Typhus had been reported in the spring of 1944 from the Normandy invasion area. Arrangements were made with the Office of the Chief Quartermaster for organization and instruction of special teams within Sterilization and Bath Units destined for the continent, to be available for disinfection whenever outbreaks of typhus fever occurred. Detailed plans were developed for a cordon sanitaire along the Rhine River, to be established promptly in case of need, once military operations had extended to that area. Lectures on insect problems, and on improved methods for louse control were given to classes of medical officers, who came from paratroop, airborne, infantry and numerous other units to the Medical Field Service School. As time for the invasion neared, a more popular and yet decidedly practical instruction was given to all officers and enlisted men of the invasion forces. The use of insecticide powder and other methods for destruction of lice were demonstrated.

In anticipation of increased demand for trained epidemiologists during the early days of the forthcoming operations, a number of medical officers were given specialized training in the control of epidemic diseases through short-term service with the central division of preventive medicine at headquarters.

Preparatory to the invasion of the continent, a large number of temporary camps had been established in marshalling areas near embarkation ports. Since the messes were by necessity largely staffed by inexperienced personnel, brief instruction in mess operation was given in numerous hospitals and camps before men were assigned to this duty. A special ration was authorized combat troops passing through the marshalling camps. In order to assure that the food was nutritious a special sanitary guide was prepared, and nutrition officers functioned as instructing supervisors throughout the areas. It was found necessary to establish feeding points at the ports, and nutrition officers were largely responsible for the development of central kitchens which assured hot food for embarking troops. (Fig. 2)

Because of certainty that the venereal diseases would have far greater significance in continental operations than in the static training period of the United



Figure 2.

Last hot meal in the marshalling areas before boarding an L.C.I. (Landing Craft Infantry) 3 June 1944.





Kingdom, existing regulations for the control of these infections were revised, and adapted to the particular needs and conditions in France. The practical and personal aspects of venereal disease prevention were incorporated in an educational approach designed to be something more than just another sex lecture. Rather, it dealt with the contraction of disease as a loss of fighting effectiveness, not only of the individual soldier but of other members of his organization upon whom his life might depend. Social customs and practices of the civilians whom they could expect to find, and the effect of the German occupation, were presented in a concise and dramatic manner.

The mounting plan included a final briefing shortly before departure, on general preventive measures conducive to the preservation of good health in the forthcoming operation, with emphasis on the ration and on venereal disease. It dealt also with disposal of wastes, the control of body lice, and with mess sanitation.

Preventive Medicine on the Continent, 6 June 1944--8 May 1945.--In projecting the probable development of the preventive medicine program in the course of continental operations, it was assumed that during the early days of the assault the exigencies of the military situation would be such as to preclude any serious consideration of disease prevention. Whatever might be done would be limited to the simple measures of environmental sanitation--the essentials of water supply, food supply, and waste disposal. These were matters of unit responsibility and provision existed for attention at that level.

According to plan, Advance Section of the Communications Zone would reach the beachheads at about D plus 8. As the first service organization to land, the Advance Section would be responsible for initiating activities in preventive medicine. At such time as the Army declared a rear boundary they would assume area responsibility for all territory between that boundary and the sea. Within actual Army areas, preventive medicine and its attendant problems would continue to be an Army responsibility. Since the Advance Section was in direct support of the field



armies and functioned in areas immediately contiguous to them and recently over-run, they would be conceivably the first to encounter the fresh problems of unsurveyed territory. This assignment required the staff in preventive medicine within Advance Section to be particularly strong. To accomplish this purpose, the best available junior members of the staff of The Chief Surgeon were transferred to this duty. From April, when Advance Section was activated, this group acted in developing plans in preventive medicine for their particular mission, being aided by various members of the theater headquarters division.

In anticipation of the time that the work of the Office of The Chief Surgeon would be divided between the base of operations in the United Kingdom and forward activities on the continent, a forward echelon of the Communications Zone (FECOMZ) was activated in April. This was actually accomplished by division of the Office of The Chief Surgeon into two parts. Lt. Colonel Arthur P. Long took up duties as chief of the preventive medicine part of the office and tentative assignment was made of six other members of the parent division. The plans for continental operations in respect to preventive medicine were largely developed by this group.

Development of the Plan in Practice.--Ordinarily no military plan proceeds precisely in the manner designed nor at the anticipated tempo. This was true in this instance. The Advance Section of the Communications Zone left as scheduled, but its Division of Preventive Medicine was not included. FECOMZ was likewise delayed, and as a matter of fact, never did come into active operations. For these reasons, a preliminary exploration of the situation in preventive medicine on the continent was made by Colonel Gordon, chief of preventive medicine who left London on D plus 30, 6 July 1944, for five days in the Normandy beach head. In the course of these observations two days were spent at the headquarters of the First United States Army, and subsequently practically all of the territory in Normandy then under American control was visited and surveyed. Opportunity was taken to confer with all principal representatives of the Medical Department, with civilian health officers, and with a number of practicing French physicians. From these sources it was learned that the last case of typhus

fever in the Continent peninsula had been reported in early May, that there was a serious question of existing indigenous malaria, that diphtheria had been prevalent the preceding winter, but that health conditions in Normandy were generally good.

The preventive medicine group of Advance Section arrived while Colonel Gordon was in the area. As a part of general plans to meet the developing situation, arrangement was made for temporary assignment of Lt. Colonel Cushing, Entomologist, and Lt. Colonel Cleland, Sanitary Engineer, to Advance Section. They were to work with that organization, with the 21st Army Group, and with Military Government G-5 in developing methods for improved environmental sanitation and insect control. These two officers arrived during the next succeeding days. In addition to their professional duties, they aided greatly in administrative details connected with the impending establishment of headquarters for the theater Division of Preventive Medicine at Valognes.

The First United States Army established a rear boundary 26 July 1944, at which time Advance Section assumed area responsibility for all territory between that boundary and the coast. The preventive medicine group in Advance Section headquarters thereafter had general and theater responsibility on the continent until the middle of August.

By theater order of 11 July 1944, FECOMZ was recombined with the parent section of ETO headquarters and in substitution of the original plan, the entire Office of The Chief Surgeon--including the Division of Preventive Medicine--was transferred to the continent and arrived in Valognes on 17 August 1944. Four officers and three men of the division were left in Great Britain to form the nucleus of a staff to serve what now became the United Kingdom Base. The Services of Supply became the Communications Zone, and that part of the organization in France had the designation Headquarters, ComZ (Forward).

Because of the rapid advances made by troops of the First and Third Armies in the course of the next succeeding days, the Division of Preventive Medicine actually took little part in what was being done in preventive medicine. The headquarters had been left far



in the rear by the sudden break-through at St. Lo. With the disruption of communications which followed, more often than not they were wholly out of contact with the field armies. What was accomplished at this time in respect to preventive medicine was largely brought about by independent and individual action by the Armies, by Advance Section and by the recently established Normandy Base Section. (Fig. 3)

Theater Headquarters in Paris. --When Paris fell in late August, it became apparent that the headquarters of the Communications Zone in order to function adequately, must occupy a position closer to the advancing armies and more nearly related to the several base sections that were being formed in liberated territory. A preliminary survey of health conditions in Paris was made by a special group concerned with medical intelligence, and likewise contact was made with such members of the municipal and national health departments as were still in the city. On request of the Surgeon of the newly constituted Seine Section, an officer was dispatched to Paris to aid in formulating a program for the control of the venereal diseases, which even in those early days of American occupation, gave evidence of being all the problem that had been anticipated. On 9 September 1944 provisional headquarters for the Division of Preventive Medicine was established in Paris. The Office of The Chief Surgeon and its preventive medicine division continued to function here until the European Theater of Operations became European Theater, 30 June 1945.

With this central location, and as the military situation became more stabilized, it was possible to undertake constructive development of the planned program for prevention of disease, and to bring into play the modifications made necessary by the changing character of the theater. The record of what took place in the autumn and winter days that followed, is to be found in the activities and interests of the several special fields of preventive medicine, as set forth in subsequent sections of this presentation. The satisfactory level of accomplishment came primarily from the contributions of the base sections, and particularly of the several armies. Much occurred; for there were no dull moments in preventive medicine during this campaign. The more common communicable diseases prevailed



Figure 3.

Advance guard of the 29th Infantry Division enters St. Lo, July 1944.





at anticipated levels of incidence except for epidemic hepatitis which occupied a prominent position. The two outstanding professional problems of the year were trench feet among troops and typhus fever among civilians.

Six base sections were organized on the Continent with their attendant problems of staffing and of organization in preventive medicine. No small part of the time of the central staff was devoted to periodic visits to these installations, to the end of developing a unified program and because of the need for advice and consultation in the many new problems which arose.

The relations of the headquarters Division of Preventive Medicine with the Armies became much closer when on 1 August 1944 our own 12th Army Group took over responsibility for operations of the United States Ground Forces after the previously existing Allied control under 21st Army Group. In the course of time, conditions in the base sections became relatively stable, while in the armies there was continuous change, because of new territory acquired and new problems encountered. It was therefore a logical development that more and more of the effort of the various specialists in preventive medicine was directed to the armies, as compared with the base sections. (Fig. 4)

The Eighth Air Force continued to maintain its headquarters in Great Britain throughout the course of the European campaign. Consequently, matters of preventive medicine of general military interest and of policy and procedure in respect to special problems, were more often a coordinated effort of officers of that organization and those of United Kingdom Base, than with theater headquarters in France. However, the over-all air force headquarters of USSTAF (United States Strategic Air Forces) which functioned on the continent gave opportunity for frequent and close correlation of theater and air force interests. The Ninth Air Force operated on the Continent in forward areas with many resultant common interests with ground force and other troops of the theater. Those in preventive medicine included among others, insect control, accident prevention measures and numerous problems in



communicable disease control.

The United States troops that invaded southern France in August were under control of the Mediterranean Theater of Operations. On 1 November 1944, these forces were combined with those of the European Theater. This brought responsibility for the Sixth Army Group, with its subsidiary Seventh United States Army. The service troops including Delta Base Section and Continental Advance Section, were incorporated into ETO as a subdivision of the Communications Zone, termed the Southern Line of Communications (SOLOC). Eventually, in February 1944, all of these organizations were absorbed into the primary structure of the European Theater of Operations which became again a unified whole.

The "Battle of the Bulge" and its antecedent American offensive in November brought about such a critical military situation that relatively little time or opportunity was presented for the ordinary affairs of preventive medicine. Trench foot was the all pervading issue. This condition first appeared on organizational reports on 8 November 1944. It reached a maximum intensity during December, was a problem of no mean magnitude in January, and continued an active interest through February.

Invasion of Germany. --The break-through into Germany in late February 1945, brought all manner of new difficulties, far and away the most prominent of which was typhus fever. That disease constituted a pertinent problem during March, became more so in April, and it was not until the end of May that the epidemic came definitely under control.

As the several armies of the theater forces advanced into Germany, a change of emphasis in preventive medicine matters took place, so marked that problems of civilian public health tended to dominate those of military preventive medicine. This was by no means either unseemly or illogical, because the health of a command is influenced strongly by the environment in which it finds itself, by the health of the civilian population in areas where it is operating. The health problems of northwest Europe in the spring of 1945 were among the civilian population. They were distressingly acute and



Figure 4.

Slogging through Germany. Filling cans at a water point near Roetgen, Germany, 10 April 1945.





decidedly a threat to the health of the Army. To decide that the best way to protect the enviable health record of the army was by direct attack on the principal source of danger--on civilian public health problems--required no great acumen. As a consequence the relations and interests of medical officers responsible for military preventive medicine and those concerned with civilian health through military government, drew closer and closer. Over shadowing all else were the health problems of the millions of displaced persons wandering over Europe. (Fig. 5) Those of German refugees were of no mean extent. The army had its own particular woe in the care of hundreds of thousands of prisoners of war who came to overcrowded cages; and in the often pitifully destitute members of our own and allied forces who were freed from German prisoner of war camps. The increasing threat of typhus fever became so alarming that something more than cooperation was necessary. Supreme Headquarters Allied Expeditionary Forces therefore directed that the control of the communicable diseases among both civilians and military personnel was to be a responsibility of surgeons at all echelons. Typhus was the principal consideration. Provision was made for pooling of resources and staff under unified control and direction of the Surgeons of Armies.

The end of the war on 8 May 1945 brought no respite to those members of the military forces responsible for preventive medicine. The month of May was perhaps the most active of any in the history of the theater, not so much because of the demands of military preventive medicine but because of the need for all medical officers to participate in the reorganization and stabilization of public health in Germany.

Aftermath of the Campaign.--The redeployment of troops directly to the Pacific Theater, indirectly to that area through the Zone of the Interior, or to the United States for discharge, got actively under way in June. A staff in preventive medicine was provided the Assembly Area Command, the great center through which most troops passed as they left the theater. These mass movements of troops brought up many health considerations; in respect to transport, staging areas, and ports of debarkation.

Newly uncovered foci of typhus fever still came



to light during June. Some of the most energetic efforts against that disease were needed before the last smouldering remains of the epidemic was stamped out. However, the success which had been promised in May came to realization by the end of June.

June was likewise a month of greatly enhanced activity in that part of the preventive medicine program devoted to nutrition. Returned allied military personnel (RAMPS) had full consideration. Numerous surveys of civilian populations were undertaken in association with officers of military government, of UNRRA (United Nations Relief and Rehabilitation Administration) and with the several special commissions originating from the Office of The Surgeon General.

The unprecedented numbers of prisoners of war and the unavoidable crowding into inadequate camps brought about a variety of health problems of which common intestinal disorders, dysentery, and diphtheria were the most prominent among communicable diseases.

United States Forces European Theater (USFET) with its subsidiary TSFET (Theater Service Forces European Theater) was organized in late June with provision for a Division of Preventive Medicine to function for troops of the occupation zone, and to take over from the Division of Preventive Medicine, ETO. The staff was drawn from those at Twelfth Army Group and ETO headquarters, Colonel Tom F. Whayne becoming chief of the newly constituted section. The European Theater of Operations came to an end on 30 June 1945, leaving to its successor, USFET, the complex problems and interests of an army of occupation, where military preventive medicine becomes so admixed with civilian public health that the two can scarcely be distinguished.



Figure 5.

The war is over. Romanian displaced persons from Buchenwald concentration camp push their way toward Vienna and rail transport to their homeland. Bavaria, 8 July 1945.





## FIGURES

- Fig. 1. Men of the infantry pack the rails of a tender bringing them to British shores from their convoy, 1942.
- Fig. 2. Last hot meal in the marshalling areas before boarding an L.C.I. (Landing Craft Infantry) 3 June 1944.
- Fig. 3. Advance guard of the 29th Infantry Division enters St. Lo., July 1944.
- Fig. 4. Slogging through Germany. Filling cans at a water point near Roetgen, Germany, 10 April 1945.
- Fig. 5. The war is over. Roumanian displaced persons from Buchenwald Concentration camp push their way toward Vienna and rail transport to their homeland. Bavaria, 8 July 1945.



## APPENDIX A

### Standard Operating Procedure for Preventive Medicine in Continental Operations

#### "A. OBJECTIVE

1. To conserve military manpower through the application of appropriate disease preventive measures.

#### "B. RESPONSIBILITY

2. Disease prevention measures must apply equally to the inhabitants of occupied territory as well as military personnel if they are to be effective. For this reason, close cooperation and collaboration between the public health authorities of occupied areas and the Chief Surgeon is imperative in the application of all preventive medical measures.

#### "C. ELEMENTS OF PROGRAM

1. Communicable Disease Control
2. General Sanitations
3. Nutrition
4. Venereal Disease Control

#### "D. COMMUNICABLE DISEASE CONTROL

##### 1. Respiratory Diseases

a. Specific diseases of immediate importance.

- (1) Epidemic hepatitis. Third only to scarlet fever and diphtheria in Germany.

b. Specific diseases of potential importance.

- (1) Scarlet fever is most prevalent. Incidence rose steadily through 1942 and 43. It is now epidemic.
- (2) Diphtheria. Common in Germany, Netherlands, and Norway.

- (3) Meningitis. Reached a ten year peak. Last peak was through 1939, 1940 and 1941. It is now on the decline.
- c. Specific diseases of long term importance.
  - (1) Tuberculosis. Most prevalent in occupied Europe and second only to malnutrition in numerical importance.
- d. General Control Measures.
  - (1) Particular attention should be directed to standards set forth in AR 40-205, AR 40-210, FM 21-10. Note: Quarantine of contacts in general is futile and will not be instituted.
- e. Specific Control Measures.
  - (1) Sulfonamide prophylaxis. Administration of 2 gms of sulfadiazine or sulfathiazole to contacts of meningococcal infections of the upper respiratory tract, in case of threatened epidemics of these diseases, will control the spread by reducing the number of carriers.
  - (2) Immunization. Scarlet fever immunization is not recommended under any circumstances. Diphtheria fluid toxoid, when administered according to SGO Circular Letter No. 162, 1942, is of value in controlling spread of diphtheria in case of threatened outbreak when administered to all contacts. Preliminary Schick testing is not essential. Passive immunization with antitoxin is impractical under ordinary conditions.
  - (3) Routine investigations. As far as possible a routine epidemiological investigation will be made of every outbreak which approximates epidemic proportions. Advice will be given on necessary measures for control.

## 2. Intestinal Diseases.

- a. Specific diseases of immediate importance.
  - (1) Common diarrheas. Chiefly in Germany.



- (2) Bacillary dysentery. Chiefly in Germany.
- (3) Typhoid and paratyphoid fevers. Chiefly in Germany.
- b. Specific diseases of potential importance.
  - (1) Amebic dysentery.
- c. Specific diseases of long term importance.
  - (1) Cholera, if imported from an epidemic area.
- d. General Control Measures.
  - (1) As set forth in existing regulations and Field Manuals.
- e. Specific control measures.
  - (1) Providing Army standards of sanitation are observed, these diseases should prove to be no problem for troops in combat or garrison. Troops will be exposed to a level of unsanitary conditions to which they have not been previously schooled, either in the United States or in the United Kingdom. There will be increased need for unit instruction of troops on essential sanitary conditions and for greater activity in routine inspections. Men on pass or furlough in civilian communities will be exposed and undoubtedly some will become infected unless sanitary control is maintained over free hours. This sanitary control should consist of the following with liberal application of the "out of bounds" prerogative:
    - (a) Thorough preliminary inspection and subsequent checking of all public water supplies for potability.
    - (b) Frequent sanitary inspections of eating and drinking establishments with an approval system for those suitable for patronage by troops.
    - (c) Prohibiting the use of any local fluid milk and dairy products.

- (d) Close medical supervision of all civilian personnel employed in a food-handling capacity (Red Cross, YMCA, Salvation Army, etc.)
- (2) Immunization. All personnel will have recently received stimulating doses of typhoid-paratyphoid vaccine, but caution must be exercised that the next typhoid-paratyphoid vaccine dose be administered within the year.
- (3) Routine investigations. Routine epidemiological investigations will be made of every reported case of cholera, typhoid fever, paratyphoid fever, and the bacillary and protozoal dysenteries to determine, if possible, the source and route of infection.
- (4) Special epidemiological reports. They will be rendered by the surgeon of organizations or stations which experience an outbreak of gastrointestinal upset. This report will be rendered to the Commanding Officer of the Base Section, attention the Surgeon, through proper channels, and will include all information pertinent to the probable cause of the outbreak together with recommendations to prevent recurrences.
- (5) Carrier Control. This will be obtained through repeated stool examinations and cultures of excreta from all probable sources and contacts. A diligent search will be made for carriers in every case of typhoid and paratyphoid fevers, and bacillary and protozoal dysenteries. No patient with one of these infections will be released from isolation until a careful study has been made to determine whether or not he may be a convalescent carrier. Every carrier of enteric infection will be governed by the stipulations of paragraph 17d, AR 40-210.

### 3. Insect-borne Diseases

#### a. Specific diseases by Vector.

- (1) Mosquitoes. Malaria is only of potential importance.



- (2) Flies. Only the intestinal infections spread by the common house fly are of importance.
- (3) Ticks, no diseases of importance.
- (4) Mites. Other than the nuisance produced by the "harvest mite" and the "itch mite" these insects are of no importance in the transmission of disease in this area.
- (5) Lice. These are of the greatest military importance;
  - (a) Typhus fever is of immediate importance.
  - (b) Trench fever is of potential importance.
- (6) Fleas. Only endemic (murine) typhus is of importance. Plague may become of importance if imported into the existing opportune set-up.

b. General control measures.

- (1) Enforcement of the pertinent sections of AR40-205, AR 40-210, FM 8-40, FM 21-10, and such existing directives as are in force or may be put in force.

c. Specific control measures.

- (1) See Section E 4 for insect control.
- (2) Internment camps, prisoners of war repatriated workers and soldiers constitute the chief reservoir of epidemic typhus, and it is of utmost importance that thorough louse control measures be applied to these groups and all military personnel in contact with them. Careful inspection and disinfestation will be made in the case of all civilians returning from infected areas. Frequent subsequent surveys for lice infestation will be made among these groups and all troops in contact with them.

- (3) Immunization. A general program for the administration of a stimulating dose of typhus vaccine to all troops should be carried out during August and September to give protection during the ensuing cold weather months. In case of an outbreak of typhus fever, typhus vaccine is to be repeated and given every four months thereafter during the course of the outbreak.
- (4) Mosquito Control. The chief vector of malaria in this area is a labranchiae stroparvus, a salt water breeder which hibernates in warm houses during the winter months. Any mosquito control plan must be modified to fit the habits of this mosquito if results are to be achieved.
- (5) Suppressive treatment of malaria. To be used with combat troops during the warm summer months, and then only in regions where the demonstrated presence of malaria so warrants. Not a significant problem here. (OCS, ETO Circular Letter No. 142, 1943).
- (6) Sanitation. Sanitary control of Sea and Air Ports (ETO letters, Subject: "Sanitary Control of Ports" and "Sanitary Control of Air Traffic" dated 9 February 1944).
- (7) Routine investigations. Routine epidemiological investigations will be made of every initially reported case of typhus, yellow fever and plague, and such recommendations will be made as may be necessary to prevent the occurrence of other cases.

#### 4. Miscellaneous Diseases.

- a. Anthrax. Of little importance. Control is largely a veterinary problem.
- b. Brucellosis. This disease is endemic but of no military importance if the use of milk and milk products from local sources is prohibited.



- c. Leptospiral jaundice (Weill's disease). Of potential importance. Intensive rodent control measures will be instituted in both civilian and military communities, as far as practicable, for the prevention of this disease as well as endemic typhus, and as a guard against the possible introduction of plague.
- d. Tetanus. Of immediate military importance. Immunization, however, should prevent the disease from becoming any problem. This region is highly contaminated with tetanus spores. In active operations with appreciable casualties booster shots every six months are recommended.
- e. Scabies. Extremely prevalent but will be of little importance, providing general hygienic measures are observed.

## E. GENERAL SANITATION

### 1. Water.

#### a. Existing and potential problems.

- (1) In northwest Europe water supplies are unreliable, and in northwest France treatment plants are almost non-existent.
- (2) Many existing water supplies can be expected to be contaminated by assault and enemy action.
- (3) In the event that chemical warfare methods are used this action will lead to further pollution of water.

#### b. Solution of water problems.

- (1) Treatment of water, in some form, will be required without exception. It will vary from plain chlorination to complete treatment, consisting of sedimentation, coagulation, filtration and chlorination. Water for drinking and cooking should never be used without

sterilization regardless of whether it is drawn from an existing system or a newly developed source. (See Office of the Chief Engineer Report entitled "Engineer Planning Data for Operations in Northwest Europe, Water Supply", dated December 1943, and other existing directives listed in Appendix.)

- (2) In case of chemical contamination all surgeons will have the responsibility of testing water and advising as to potability and required methods of purification.

## 2. Sewage Disposal

### a. Existing and potential problems.

- (1) Primitive methods of sewage disposal such as night pails, cess pits and cess pools are common.
- (2) Enemy destruction of existing sewage disposal plants may be anticipated.

### b. Solution of sewage problems.

- (1) AEF standards for sanitary waste disposal are completely covered in AEF Construction Standard No. 10, Office of the Chief Engineer, ETOUSA, 11 January 1944.
- (2) The practice of eating uncooked vegetables grown locally must be discouraged due to widespread practice of utilizing night soil for fertilizer.

## 3. Rodent Control.

### a. Existing and potential problems.

- (1) Rodents will have increased tremendously and accompanying sanitary problems likewise. Buildings destroyed as a result of warfare will provide numerous rat harborage.

### b. Solution of rodent problems.



- (1) Rodent extermination is a function of the Corps of Engineers, but advice and supervision must be rendered by the Medical Department. To be effective all rodent control programs must be coordinated between military and civilian communities, requiring cooperation on the part of the Civil Affairs Division.

#### 4. Insect Control

##### a. Existing and potential problems.

- (1) Typhus fever (epidemic and murine). Exists in certain parts of northwest Europe and the constant danger of widespread and explosive epidemics among civil populations is an ever-present threat to the health of military personnel. These and other louse and flea borne diseases require unrelaxed diligence in the control of the insect vectors.
- (2) Mosquitoes. Important pests in Continental Europe. Along the coast of northwest Germany, Holland, Belgium and France benign tertian malaria, transmitted by the brackish water-breeding species of Anopheles, A. Labranchiae atroparvus is likely to be encountered. In almost every locality, certain species of pest mosquitoes such as Aedes vexans and Culex molestus will occur in sufficient numbers to affect the comfort of troops.
- (3) Flies. The housefly Musca domestica will be an important insect not only from the standpoint of the dissemination of intestinal diseases but as a nuisance. Some species of biting flies will be abundant enough to cause considerable annoyance in some localities.
- (4) Bedbugs. Must be expected any place on the Continent. Billets selected for troops are almost certain to be infested.
- (5) Cockroaches. They will infest kitchens, mess halls, and food storage places.

- (6) Chiggers and harvest mites. Common pests in the European countries. Infestations will be picked up by troops operating or bivouacked in low lying grassy and bushy areas principally along streams, and from sleeping on infested straw.

b. Solution of insect problems.

- (1) The prevention of epidemic typhus among troops depends on a rigid louse-control discipline. (OCS Cir. Ltr. No. 19, Medical Bulletin No. 12, OCS, 1 November 1943; SGO Cir. No. 33, 2 February 1943). Surveys should continually be made among the civil population in the occupied area to determine the presence of cases of epidemic typhus and the degree of influx of refugees from endemic areas. In the event cases occur, control measures by a special Typhus Control Unit will be initiated at once.
- (2) Outbreaks of murine typhus and plague are unlikely but may occur in ports. This will necessitate thorough rat control campaigns. (FM 8-40; OCS. Med. Bulletin No. 9, 1 Sept. 1943).
- (3) During outbreaks of typhus and plague recommendations on the isolation of patients and certain degrees of restriction on the movement of both military personnel and civilians will be made to the C.G., C.Z. at once. (FM 8-40; SGO Cir. No. 33, 2 Feb. 1943).
- (4) Mosquito control will be enforced chiefly to control pest mosquitoes, since very little malaria is anticipated. The control measures will consist of the following:
  - (a) Use of repellent, protective clothing, bed nets, screens.
  - (b) Control of mosquitoes by spraying tents, billets or other sleeping quarters with insecticide, freon aerosol. The breeding habits of the principal malaria vector in northwest Europe are such as to preclude the use of larvicidal measures for the control of the particular Anopheline species. Most of the malaria contracted in the area is due to the biting of mosquitoes in human habitations.



Spraying of sleeping quarters should be done twice daily.

- (c) Treatment of local breeding places by units within camp area.
- (d) Treatment of general breeding areas. Surveys to determine location of large breeding areas. Surveys to determine location of large breeding places and recommendations made to the Corps of Engineers regarding methods of preventing breeding. (WD Cir. No. 223, 21 Sept. 1943; WD Training Cir. No. 108, 21 Sept. 1943; SGO Cir. No. 33, 2 Feb. 1943; SGO Cir. No. 22, 16 Jan. 1943; FM 8-40).
- (e) Hospitalization of malaria patients. Malaria patients will be hospitalized, insofar as possible, outside the breeding area of Anopheline mosquito vectors.

(5) Fly control.

- (a) Proper garbage and sewage disposal (See section on these procedures).
- (b) Use of fly ribbons, traps, fly swatters.
- (c) Use of insecticide, freon aerosol or Insecticide, liquid, finished spray. The sprays are most efficiently applied by closing the windows and doors, directing the spray toward the ceiling and leaving the room closed for an hour or two. The work should be done late at night when the room is least used. Two or three sprayings per week when done properly will affect a good control of flies in buildings. Food should be covered during spraying operations.
- (d) Screening. Food preparation and storage rooms, mess halls, and operating theaters of fixed hospitals will be screened. (SGO Cir. No. 33, 2 Feb. 1943; Engr. Bulletin No. 63, 3 Aug. 1943; Engr. Bulletin

71, 21 Aug. 1943; Engr. Bulletin No. 76,  
11 Sept. 1943; Engr. Bulletin No. 114,  
17 Jan. 1944; FM 8-40).

- (6) Bedbug control will be accomplished by spraying or dusting beds, bedding, cracks in floors, walls, and ceilings with insecticides, liquid, finished spray or Insecticide, powder, body insect. (FM 8-40).
- (7) Cockroach control.
  - (a) Cleanliness in kitchens, mess halls and food storage rooms.
  - (b) Use of Insecticide, powder, roach. (FM 8-40).
- (8) Chigger and Harvest Mite Control.
  - (a) Through the use of repellent, insect or insecticide powder, body insect. Troops in areas where chiggers occur can obtain good protection against infestation by applying repellent to all the openings of the clothing such as the shirt collar, the front of the shirt, the fly, waist and cuffs of the trousers, bottom and top of leggings, and along the laces of shoes and leggings. Dusting the drawers especially along waistline, the inside of the trousers, socks and leggings with Insecticide, powder, body, insect will also protect against chiggers.
  - (b) Straw which is infested with harvest mites can be freed of these pests by spraying with Insecticide, liquid, finished spray or dusting with Insecticide, powder, body insect.

## F. FOOD AND NUTRITION

### 1. Objective

- a. To make such investigations and recommendations concerning the character, adequacy and preparation of food insofar as they have a bearing upon the physical condition of troops.



## 2. Necessary action

- a. To determine the adequacy of field and hospital rations and to make recommendations designed to maintain the nutritional well-being of troops.
- b. To assist in the instruction of mess personnel in the attainment of good messing; i.e. the preparation and service of tasty, clean food with a minimum of waste of food and its nutrients.
- c. To assist in the instruction of officers and enlisted men in food values and in the necessity of individual responsibility for nutritional health.
- d. To make recommendations, as requested by the Civil Affairs Section, concerning the feeding of civilians in occupied or liberated areas.
- e. To advise the Quartermaster on the issue of substitute ration items, and on the proper use of foodstuffs which are procured from local sources.
- f. To make recommendations, as requested by Surgeons of Tactical Forces, concerning the subsistence of combat troops supplied emergency or processed rations, and concerning the feeding of casualties.
- g. To investigate and make recommendations concerning the feeding of troops in rest areas or rehabilitation centers with particular reference to troops previously subsisted on emergency rations.
- h. To advise medical officers and officers of the Quartermaster Corps in assisting unit commanders to achieve the highest possible standards of mess sanitation and of food service.

## G. VENEREAL DISEASE CONTROL

1. The Venereal Disease Control Program for continental operations will be based on full exploitation of educational methods, provision of prophylactic materials and facilities, epidemiologic methods, command functions and responsibilities, and cooperation with other agencies.

2. There will be in the offices of the Base Section Surgeons a full time venereal disease control officer who will be provided with the following:
  - a. Such assistant venereal disease control officers as are required to implement the program.
  - b. Nurses trained in contact investigation to implement the program outlined in paragraph 9.
  - c. Transportation facilities adequate for himself and staff at all times.
3. A general program of factual education regarding the venereal diseases will be carried on and special emphasis will be given to the following:
  - a. The incidence of the venereal diseases in the contiguous civilian population.
  - b. General and special protective measures which may be employed.
  - c. The lack of basis for the "last fling attitude".
4. Provision of prophylactic materials and facilities.
  - a. Administrative orders will be issued for the supply of the following:
    - (1) Condoms will be provided at the rate of 6 per man per month.
    - (2) An approved chemical prophylactic kit (at present the "V" Packette") will be provided at the rate of 2 per man per month.
    - (3) Prior to embarkation a 15 days' supply of each of these prophylactics will be issued to each unit, as a unit reserve, and issued under the direction of the unit commander.
    - (4) Hospitals will carry a stock of these prophylactics for supplementary issue to individuals.



- (5) After the assault phase, bulk shipment of these prophylactics will be made to Class II and IV depots, dumps or distribution points.
  - (a) Issues will be made from these Class II and IV depots, dumps or distribution points on unit requisition and the supplies to be held as unit reserve will not exceed 15 days.
  - (b) Prophylactic stations will be established in locations which will afford maximum availability. They will be under the supervision of the Surgeon of the Command concerned and will be operated by enlisted men trained for these duties.
  - (c) Full utilization of suitable prophylactic facilities offered by other agencies will be authorized.

5. Recreational facilities.

- a. The maximum utilization of recreational facilities will be made for men in rest and furlough areas and in all other areas where feasible.

6. Repression of Prostitution.

- a. The Commanding General and all Commanding Officers will be advised that any program of toleration, supervision, support or encouragement of commercialized prostitution is contrary to the best principles of public health and is a detriment to the health, morale, and efficiency of troops.
- b. The Commanding General and Commanding Officers are advised to develop a policy of full scale repression of prostitution. In this respect it is suggested that maximum cooperation be maintained between all available agencies with particular reference to local governments, military and civilian governments and other military services.

- c. The Commanding General and Commanding Officers will be advised to direct the Provost Marshal to exercise the powers of the military police as much as possible in the repression of prostitution, with particular reference to the following control measures.
  - (1) Houses or areas in which prostitution is known or reasonably suspected to occur will be placed "out-of-bounds" to all military personnel.
  - (2) Violations of an "out-of-bounds" order will be considered a serious offense.
  - (3) A reasonable curfew hour will be established and enforced.
  - (4) There will be adequate military police to enforce paragraphs c. (1), (2) and (3).
- 7. In exercising the command function, unit and higher commanders will be advised:
  - a. To ensure sufficient policing of camp and bivouac areas to prevent the entry of unauthorized individuals.
  - b. To control troops in transit so as to prevent clandestine sexual intercourse.
  - c. To hold bed check in rest areas in order to substantiate the curfew.
- 8. Cooperation with other agencies.
  - a. Full cooperation will be given to all agencies engaged in the establishment and maintenance of effective venereal disease control programs both in the civilian population and among the personnel of other military services.
  - b. Where facilities are inadequate for the proper control or treatment of the venereal diseases among the civilian population the use of materials and personnel of the United States Army Medical Department will be authorized.



## 9. Case Finding

- a. Epidemiologic investigation of the sex contacts of soldiers with venereal disease will be established in rest and furlough areas and elsewhere as soon as the military situation permits. This will be done under the direction of a medical officer utilizing the personnel provided for in Section 2b.

## 10. Punitive Measures

- a. The provisions of Section III, Circular Letter No. 2, Hq. ETOUSA, 5 Jan. 1944, will be strictly observed.

## H. DRUGS AND SUPPLIES.

### 1. Communicable Disease Items

<u>Item</u>	<u>Stock No.</u>	<u>Unit</u>	<u>Required per 1000</u>	<u>Availability in relation to D-Day</u>	<u>See "Rules"</u>
Atabrine tablets, 100 mgm,	10845	100	300	D / 30	(a)
Cholera vaccine, 20 cc.	16015	Vial	75	D / 30	(b)
Diphtheria toxoid, USP plain, 10 cc.	16041	Vial	250	D / 30	(b)
Plague vaccine, 20 cc.	16070	Vial	75	D / 30	(b)
Sulfathiazole, USP 7.7 gr. tab.	14641	1000	0.1	D / 30	(c)
Small pox vaccine, USP 10 cap tubes in pkg.	16090	Pkg.	100	-	(d)
Tetanus toxoid, plain 30 cc.	16127	Vial	35	D / 15	(e)
Typhus vaccine, 20 cc.	16128	Vial	50	D / 60	(d)
Vaccine, triple typhoid, prophylactic	17300	1 cc.	1000	D / 60	(d)

### 2. "Rules" governing communicable disease items.

- a. Atabrine supply sufficient for 10,000 men for one month to be stored in communications zone for use as required.

- b. These biologicals will be stored for emergency use in an amount sufficient to inoculate 12,000 men.
  - c. Sulfathiazole requirement is based on estimate for prophylactic needs only. One hundred package units should be held in reserve in the warehouse to supplement unexpected depletion of ordinary supply, in case this drug must be used as a prophylactic measure against an outbreak of meningococcal or streptococcal infection.
  - d. These vaccines will be required in the estimated amounts during the year following D-Day to complete the annual stimulating inoculations.
  - e. The estimated requirement of tetanus toxoid is based on the anticipated need for casualties and reimmunization during the ensuing year.
  - f. Venereal disease control items will be drawn from Quartermaster in accordance with Administrative Circular No. 23, Hq., ETOUSA, dated 9 March 1944. by D / 15.
3. Supplies for water purification, delousing of clothes and equipment, and for the control of insects and pests will be drawn from Quartermaster in accordance with administrative Circular No. 23, Hq., ETOUSA, dated 9 March 1944, in such amounts as may be needed according to area by D / 15.





A HISTORY OF PREVENTIVE MEDICINE  
IN THE  
UNITED STATES ARMY  
1941 - 1945

PART II - Organization of Preventive Medicine Service in ETO

by

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Office of the Chief Surgeon, ETO





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## PART II

### Organization of Preventive Medicine Service in ETO

A general policy intended to guide theatre activities in preventive medicine was set forth at an early date. It defined the principal objective in simple terms - to further all measures designed to improve the health, the physical well-being and the morale of the army.

The Chief Surgeon of the European Theater of Operations had a dual responsibility. The first was in over-all direction of medical activities in the theater, the second as Surgeon of the Communications Zone. The Division of Preventive Medicine in the Office of the Chief Surgeon therefore had direct supervisory responsibility for preventive medicine as it related to all sections of the Communications Zone and of the Services of Supply which preceded it. The Division acted in advisory capacity to the surgeons of field armies and of air forces, through the respective Army Groups and the United States Strategic Air Forces, (USSTAF). The two United States Army Groups, the Twelfth and the Sixth, exercised much the same relationship to the Armies, the First, Third, Seventh, Ninth and Fifteenth United States Armies, as did the Chief Surgeon to bases and base sections of the Communications Zone in the course of his secondary responsibility as Surgeon of the Communications Zone. Likewise, (USSTAF) had a similar function in respect to the Eighth and Ninth Air Forces.

Affairs in preventive medicine that required a uniform policy for all Allied Forces, or joint action by any one or more with American Forces, were initiated through SHAEF (Supreme Headquarters Allied Expeditionary Forces) and its Chief Medical Officer. Such action came into play in respect to a number of wholly ordinary and usual activities in preventive medicine, such as the control of the venereal diseases. It found its most useful application in emergency situations such as the control of typhus fever in Germany, in problems of displaced persons, and in the many other ramifications of civilian health under military government.



Headquarters of Field Armies had direct operational responsibility for the preventive medicine activities of combat divisions and separate units; and division headquarters largely in turn determined what unit surgeons should do in the maintenance of health. The general organizational scheme of the Medical Department provided no lack of advice, of supervision, of direction or of coordination. But to assume that this was what determined the first rate health record, would be a mistake. The vast proportion of routine health service rendered to troops of the command was delivered by the unit surgeon. The preventive medicine organization at theater level may subsidize and indirectly shape the local health service. The Preventive Medicine Division of an army may determine major policies for battalion surgeons, set the standards, promulgate regulations, and even directly supervise his activities; but the final determining factor in the effectiveness of a preventive medicine program rests with the workers in the locality where the problems are occurring. Belief in this principle dominated practice in preventive medicine in the European Theater.

It was stressed at upper command level to the extent that during the period of active operations it was rarely possible to assemble at any one time the complete staff of the Division of Preventive Medicine in the Office of The Chief Surgeon. Some men were inevitably away on field duty; not uncommonly half the staff was so engaged; and in times of stress, as in the course of a typhus epidemic, the central office was almost barren of personnel. There was nothing but acclaim for the Army preventive medicine officer who regularly each month visited all of his divisions; brought word of new directives, policies and problems; and conferred with regimental and battalion surgeons on the specific difficulties they were having. It reached its ultimate in a squadron surgeon sitting about of an evening with perhaps twenty men of his particular air base, giving no sex lecture but frankly and informally talking about venereal disease. It is essential to carry preventive medicine to the consumer; it cannot be successfully transmitted through channels by written directives.

Before continuing discussion of the general organizational features of preventive medicine in the

various forces of the theater, a word is to be said of personnel. After all, it is men who make an organization, not tables of organization nor directives nor lines of authority. With no intent of detracting from the accomplishments of the men who did the work in preventive medicine---two outstanding deficiencies in training and qualifications have come out of this experience. The first is in respect to the physicians who did the work of the day-- the unit surgeons.

A lack of command of the principles of preventive medicine was too generally evident. Too often the actual practice of preventive medicine, sometimes even of the simplest technics such as small pox vaccination, verged on apparent entrance into a new world. This marks a fundamental deficiency in medical education, and the remedy lies with medical educators.

The second shortcoming had to do with positions in preventive medicine of high administrative responsibility of requiring specialized skills.\* Many were filled by officers with neither professional training in public health, nor experience in public health practice. In the European Theater there may be said to have been at the height of its strength, thirty key positions in preventive medicine. Eleven of the thirty officers had had training in public health or in one of its special disciplines. Five others qualified on the basis of experience. Almost one-half were selected from physicians with good training in internal medicine or pediatrics, who had been accustomed to take leadership and assume responsibility. Consideration should be given this problem by those concerned with future planning for the Medical Reserve Corps and the peace time military structure. The next expeditionary force needs to be assured of sufficient qualified and experienced specialists in preventive medicine. In the recent past experience, too many of this relatively small group were crowded into a few of the services. The Regular Army was altogether too small.

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\*This shortcoming has been recognized and is rapidly being corrected. Adequate numbers of Regular Army medical officers have received and are receiving post-graduate training in civilian schools of Public Health and Hygiene.



The Division of Preventive Medicine, Office of The Chief Surgeon.--Activities in preventive medicine at theater level centered in the Division of Preventive Medicine of the Office of The Chief Surgeon. This was one of eleven divisions into which the work of that office was divided. The Division of Preventive Medicine, in turn, was constituted of several branches which varied in number with general organizational changes in the Office of The Chief Surgeon. The branches likewise varied from time to time in importance and activity, dependent upon the nature of the existing problems. The officers who headed the several branches were of such calibre that each branch tended to function independently, each responsible for the work in its particular field of interest whether it was nutrition, venereal disease or insect control. It is not to be interpreted, however, that the work of the division was strictly categorized. Full exchange of aid, as well as of advice, took place when problems involved the interest of more than one branch. The resources of several branches were not infrequently turned to the aid of another to meet the emergency needs of a special situation. Some of the best work in trench foot was done by an entomologist and the gas casualty officer. Through some special assignment at one time or another, the chief of the venereal disease control branch took part in the activities of about every other branch of the division, and to all intent and purpose was the trouble shooter of the division.

The branches of the office included at various times organized activity in epidemiology, venereal disease control, medical intelligence, sanitation, military occupational hygiene, laboratories, gas casualties, and nutrition. The bulk of the work centered in four branches--Epidemiology, Venereal Disease Control, Sanitation and Nutrition.

The branches of Military Occupational Hygiene and of Laboratories functioned throughout the life of the theater. The work in occupational hygiene consistently overlapped into the interests of all other branches. The supervision of theater laboratory service was strongly supported and reenforced by the aid which came from the commanding officer and the staff of the First Medical General Laboratory.



The Medical Intelligence Branch was established in the early days of the theater. It continued operations until 6 November 1943, at which time the scope of interests in this field was extended beyond its original conception, to include evaluation of scientific activities in enemy countries, medical education and other features. The work of the existing branch in the Division of Preventive Medicine was transferred to the newly constituted Medical Intelligence Branch of the Operations Division, except for matters concerned primarily with communicable disease, which were incorporated in the Epidemiology Branch.

For administrative reasons the Gas Casualty Division which had long been an independent part of the Office of The Chief Surgeon was on 13 January 1945, transferred to the Division of Preventive Medicine as one of its branches. It so continued until 11 June 1945 when work in this field reverted to its previous status of an independent division. An organizational chart of the Division of Preventive Medicine as constituted in 1945 is shown in Fig. 1.

In contrast to the organizational plan originally holding in The Surgeon General's Office, work in nutrition in the ETO was incorporated within the Division of Preventive Medicine, rather than in the Division of Professional Services. This has served to emphasize the preventive aspects of nutrition, with no loss of attention to the dietary needs of hospital patients or the management of deficiency diseases. The Division of Preventive Medicine thus followed the pattern of most good civilian health departments in stressing nutrition as a major part of a preventive program, with activities in that field closely integrated into the general program for the maintenance of health. This emphasis on the diet of the healthy soldier led to unusually close association with the Subsistence Division of the office of the Chief Quartermaster.

A second and individual administrative feature was in respect to venereal disease control. Almost without exception, in both civilian and military practice, prevention and treatment of the venereal diseases are combined in a single program under a single direction. The

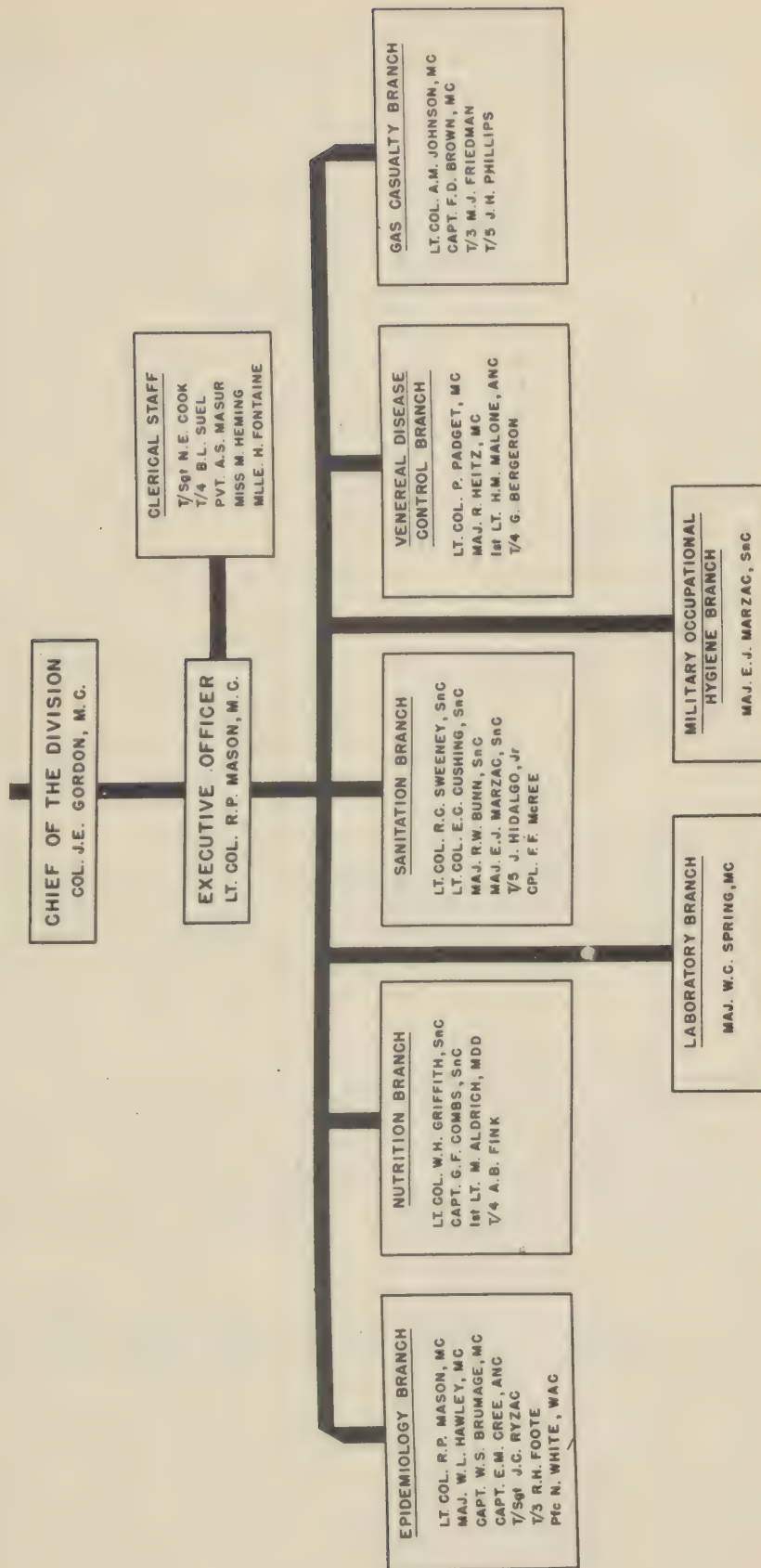
Chief Surgeon saw fit to delegate the treatment of the venereal diseases to the Division of Professional Services and the development of a program for prevention and control to the Division of Preventive Medicine. This was logical and potentially promising of a better total effort. With direction of a venereal disease program by a clinician, prevention is likely to suffer; and with a public health man at its head, treatment is rather certain of under-emphasis. Such a division of interests has furthermore characterized the history of most developments in preventive medicine, notably in respect to the common communicable diseases, tuberculosis, cancer and pneumonia. Without exception the impetus toward prevention originated from the clinic and the bedside. The development of technical methods of prevention came with the interest of trained public health workers. Prevention reached its full potentiality, however, only when it attained equal standing in effort and importance with the clinical problem.

Continuity of service of key personnel contributed as much as anything to the accomplishments of the division. The chief of the division acted informally from the earliest days of the theater, later became Consultant in Preventive Medicine, and continued as chief throughout the existence of the theater. A similar situation likewise held for two of the major branches, with Major (later Colonel) Griffith in Nutrition, and Major (later Lt. Colonel) Padget in Venereal Disease Control. It was essentially true for the Sanitation Branch. While work in this field was started by Lt. Colonel Sweeney, it was under the direction of Major (later Lt. Colonel) Cleland during the greater part of the theater's existence, with Lt. Colonel Sweeney returning toward the end of operations. To a large extent, the same state of affairs held true in respect to junior members of the staff, except for those who left because of qualifying for more senior positions. The chief of the division was fortunate in the quality of officers and men assigned to the staff, and still more fortunate in being able to hold them together.

Preventive Medicine in the Services of Supply.--  
Base sections were first formed in the Services of Supply in late 1942. While organizational plans were well under



**ORGANIZATION CHART  
DIVISION OF PREVENTIVE MEDICINE  
OFFICE OF THE CHIEF SURGEON**



**Figure 1**





way that autumn, no instance existed in which a base section had a complete and functioning Division of Preventive Medicine before 1943. As the emphasized policy of decentralization became established and more and more responsibility was delegated by the Chief Surgeon to Surgeons of base sections, Divisions of Preventive Medicine at that level increased in size and progressively developed comprehensive programs. By the end of 1943 all base sections had complete departments of preventive medicine, organized on the basis of four branches--epidemiology, nutrition, sanitary engineering and venereal disease control. They were adequately staffed, and functioned more or less independently within their areas, directing and supervising all activities in the field. Perhaps the strongest organization in a base section was that of Southern Base Section, as was proper, since the heaviest concentration of troops was in that region. The two other base sections, Western and Eastern were adequately staffed and organized.

The preventive medicine staff at Central Base Section in the London area was smaller, but sufficient to meet the needs. Epidemiology and venereal disease control were under the direction of a single officer, the medical inspector. A nutrition officer was assigned later in the history of the organization.

The North Ireland Base Section was organized late in 1943. It gathered a strong staff, which was necessary because of the variety of problems peculiar to North Ireland and because of its relative isolation. The areas of the United Kingdom included within the several base sections are presented in Fig. 2.

The base sections were responsible for preventive medicine affairs relating to Services of Supply troops within their respective areas, and in addition had area responsibility for such matters as water supply and waste disposal. Ground forces stationed within a base section had unit responsibility for preventive medicine within their organization, as did the air forces.

Preventive Medicine in the Communications Zone.--With the beginning of continental operations, the

former Services of Supply became the Communications Zone. As of 1945 it included a headquarters in Paris, six base or intermediate sections within continental Europe, two advance sections and a single base, that of the United Kingdom. (Fig. 3)

United Kingdom Base.--The original five base sections which had operated in the United Kingdom under the Services of Supply were contracted into a single unit, the United Kingdom Base. The base was further divided administratively into four districts, corresponding in general to the areas previously included within the base sections of Great Britain proper. Operations in North Ireland had by this time practically ceased. A strong staff for preventive medicine, drawn almost entirely from the Office of The Chief Surgeon, remained in Great Britain under command of Major C. M. Eberhart. Its responsibilities were heavy, in that for all practical purposes it took over obligations for installations and areas which had previously engaged theater headquarters. The United Kingdom furthermore became the principal center for hospitalization of casualties.

The districts had individual representation in preventive medicine in some instances, usually one officer, but no formal preventive medicine division was established at that level. The work of the base was directed centrally from its headquarters, London. The districts were later dissolved, and base organization and administration became essentially that of Service Commands in the zone of the interior. A certain amount of decentralization was still practiced, however, through assignment of special officers in preventive medicine to hospital centers to work in surrounding territory.

Base Sections.--The well-organized divisions of preventive medicine which came into being within the various base sections of the United Kingdom in 1943, served as a nucleus for staffs in similar positions in the newly organized base sections of the communications zone on the continent. In addition to Advance Section, there were six such organizations in the original area of the European Theater of Operations; the Seine, Brittany, Normandy, Channel, Oise, and Loire Base Sections, although the latter was short-lived, eventually being absorbed into Brittany Base Section.





Figure 2

Map of United Kingdom showing boundaries of base sections,  
Services of Supply, 1943.





Figure 3.

Map of Western Europe showing boundaries of advance and base sections, Communications Zone, 1945.





On 1 November 1944, the military organizations concerned with operation Anvil and the invasion of southern France, were incorporated into the forces of the European Theater. This brought two more sections into the structure of the Communications Zone, the Continental Advance Section and the Delta Base Section. At first, these two organizations functioned as a special branch of the Communications Zone known as Southern Line of Communication (SOLOC). This arrangement was terminated 12 February 1945, and thereafter the two sections operated on the same basis as all others, functioning directly under Headquarters, Communications Zone. (Fig. 3)

Each base section on the continent had its own division of preventive medicine, usually composed of four officers and varying numbers of enlisted men, organized under four branches: those of epidemiology, venereal disease control, nutrition, and sanitation. In the early days practically all base sections had the advantages of the services of additional officers, on temporary duty from various nearby replacement depots.

The base sections did the work of preventive medicine for the Zone of Communications and it was well done. The Normandy Base Section particularly had a continuously high level of performance, despite the fact that it was called upon to bear the brunt of early activities in the Communications Zone at a time of much disorganization and difficulty. It contributed greatly toward defining the pattern for preventive medicine activities in the Communications Zone generally.

Delta Base Section served a particularly large area and was relatively far removed from the center of activities at Headquarters, Communications Zone. It had many individual problems. Because of its location in the south of France, it included the only significant malarial area of the theater. Its port facilities at Marseilles were among the most extensive in the theater. After the termination of hostilities, it served as the principal debarkation area for troops deployed directly to the Pacific by sea, and by air to that area and to the Zone of the Interior. For these

several reasons, Delta Base occupied much the same situation as did the North Ireland Base Section under conditions across the channel. It had unusual need for individuality and independence in action. Its staff included the four usual components of a base section division of preventive medicine, and in addition a specialist in malaria control. Delta Base Section was the only part of the Communications Zone having an individual laboratory service, the Fourth Medical Laboratory serving its needs and those of the nearby hospitals.

Channel Base Section had more than the usual obligations of a communications zone area because of the inclusion within its territory of the three main ports serving the theater, those of Antwerp, LeHavre, and Rouen. Its activities in deployment of troops after hostilities ended were the greatest of any base section, because the great Assembly Area Command was located near LeHavre.

Advance Section.--The Advance Section was an integral part of the Communications Zone, and yet its particular mission gave rise to difficulties and problems in preventive medicine which were many times distinctive and individual. It had area responsibility, as did other sections of the Communications Zone, but with the difference that its area was neither fixed nor stable. Designed to give direct support to the Armies as the most forward supply organization, it moved when the armies moved and its area of responsibility and its headquarters shifted frequently. In preventive medicine matters, Advance Section maintained unusually close relation with the armies, for as they moved forward Advance Section moved in. Many situations which the army had barely defined in the course of a brief occupation, were left to Advance Section to stabilize and to organize; and many times to investigate and evaluate. It had the first contact with new problems falling under jurisdiction of the Communications Zone. The Sanitary surveys that it made of all recently occupied territory were of particular value to the armies concerned, and to the whole preventive medicine program.

Advance Section was the first Communications Zone unit to set foot in Normandy. In the beginning it was attached to the First Army, but began to function independently when a rear boundary was prescribed on



26 July 1944. It followed on with the First Army until the end of the campaign. When the Third Army entered the Normandy campaign, the duties of Advance Section were extended to include that organization; and still later it assumed supply obligations for the Ninth United States Army.

In addition to the usual features of preventive medicine, the Division in Advance Section also carried responsibility for medical records. Its staff was somewhat larger than that of most Communications Zone sections, and from time to time was further augmented by assignment of officers on temporary duty to meet special or unusual needs, many times from the Office of The Chief Surgeon.

Continental Advance Section.--Since it served only the Seventh United States Army, the activities of Continental Advance Section were less extensive than those of Advance Section. Nevertheless its mission was of the same character and its duties as diversified. Its period of greatest responsibility came during the rapid advance of Seventh Army troops from the coast to the Vosges mountains. Throughout its service, Continental Advance Section was called upon for much individuality of action. The Seventh Army and Continental Advance Section were stationed at the easternmost end of the battle line. For this geographic reason alone, there was less contact between the Seventh and the other armies than was ordinarily true, a condition further exaggerated in that the Seventh Army functioned alone under the Sixth Army group, thereby missing the community of interests which came from common association as with the First, Third, and Ninth Armies under Twelfth Army group. Since the First French Army was also under tactical direction of the Sixth Army Group, Continental Advance Section had many liaison duties which Advance Section did not.

Preventive Medicine in the Ground Forces.--  
During the time that the First and Third Armies were stationed in Great Britain, their activities in preventive medicine had to do primarily with training and organization; and with planning for the practices and procedures to be put into effect when they became operational on the continent. With the base sections taking area responsibility for many of the fundamental procedures

of preventive medicine, the activities and obligations of the ground forces did not extend much beyond the practice of good preventive measures on a unit basis.

Conditions were decidedly different when they went into operations on the continent. The field armies were then responsible for all preventive medicine activities in their defined operational areas, and for the health of their troops. As the major operational unit, the field army preventive medicine staff took on the stature which the size and importance of its obligations demanded.

At the beginning of continental operations, the First United States Army was under tactical control of the 21st Army Group, a combined allied organization, and while technical control in medical activities including preventive medicine remained with United States Headquarters, actually little help or support was extended. The solid ground work in preventive medicine practice for an army in the field which developed at this time, came wholly from the efforts of the First Army medical staff.

When the Twelfth Army Group became operational 1 September 1944, tactical and technical control of the First and Third United States Armies came under direction of this higher headquarters. The new arrangement gave a direct channel for flow of activities in preventive medicine from Theater Headquarters at ETO through the army group to the several armies. This became still more significant as the Ninth and Fifteenth Armies came into operation under the same jurisdiction.

Preventive medicine was an activity strongly stressed by the Surgeon of the Twelfth Army Group. While no technical staff was maintained at that level, the work was under the direction of a qualified and senior officer who devoted all of his time to this interest. Affairs in preventive medicine having to do with the armies were regularly routed through this office, and direct contact with armies was avoided in order that completely correlated effort might be attained. There was the liveliest exchange of information and effective coordination of the general preventive program. Preventive medicine personnel were loaned to the armies on many occasions through the auspices of Twelfth Army Group, and the full facilities



of the theater were at the disposal of the armies, to the end of assuring that combat troops above all others had adequate preventive medicine service. The strength of this relation came from the close working arrangement which existed between preventive medicine officers at Twelfth Army Group and ETO Headquarters.

The Sixth Army Group played a similar part in respect to the Seventh United States Army. Since the Seventh was the only United States Army under its jurisdiction, the other being the First French Army, the staff of the Surgeon was small. There was no formal organization in preventive medicine, and no officer was specifically assigned to that field. The work was carried out as a part of the general activities of the office of the surgeon.

All five field armies had regularly constituted provision for preventive medicine. Collectively, these Army organizations brought preventive medicine to the great bulk of the troops of the theater. Not only were they responsible for the greatest numbers, but the problems that they faced were multiple and often unusual, and there was the constant need for prompt action. A moving army in the field has difficulties non-existent to troops operating from a fixed base. Without exception, the level of accomplishment was outstanding.

Organically, the four-part preventive medicine service was typical of armies, except that the Division of Preventive Medicine of the Seventh United States Army included a malariologist from the days of their operations in Africa and Sicily. There was almost universal appreciation of the valuable contributions that sanitary engineers can make to a field army. Greater stress could in most instances have been placed on nutrition, which in recent years has become a strongly emphasized interest in military preventive medicine. Nutrition is an especially important consideration to a field army, a fact which Napoleon and the great generals of all time have recognized. There is every reason for the modern military leader to take full advantage of the recent day discoveries that have been made in this field.

At this top operational level, the role of preventive medicine was appreciated without exception to be



more a field than a staff activity. Officers assigned to this work developed sound field practice to a high degree, supervising the work of their divisions, investigating problems uncovered during the course of operations by forward elements, and bringing to combat units the practical aid and familiarity with the general army area situation so essential to good preventive practice.

Supervision and direction of preventive medicine in corps and in divisions was provided by Medical Inspectors. At corps level the duties were more supervisory and consultative. In divisions, the medical inspector was decidedly operative. While occupied to an extent with the other duties of his office, the divisional medical inspector was in essence the preventive medicine officer of this major unit. In a number of corps and divisions, Surgeons had as an assistant a sanitary corps officer, either a nutritionist or a sanitary engineer. This would seem to have been a worthwhile addition, particularly to staffs of divisions, through effecting a saving in medical personnel and at the same time providing a specialist in disciplines not always wholly familiar to Medical Corps officers.

Preventive Medicine in the Air Forces.--A firm emphasis on preventive medicine carried through the medical services of the air forces. It so happened that the first fully organized and independently functioning division of preventive medicine in any lower echelon of the theater was that of the Eighth Air Force Composite Command, which arrived in North Ireland in September 1942 with a full complement of officers for preventive medicine.

The strongest part of the air force program in preventive medicine was that relating to the personal health of the individual soldier--those factors which contribute to his efficiency as a fighting man, the every day features of food, clothing, relaxation, rest and recuperation. The soldier, like the worker in industry, encounters certain specific health hazards because of his occupation as a soldier. While this is particularly true of the soldier in the air forces, it is by no means individual to him and certainly no more so than to men serving in the tank corps or to the

paratroopers. At any rate, attention to this important consideration saw a higher development in the air force in this theater under field conditions than in any other branch of the service. A special group at air force headquarters was continuously engaged in the study of these problems and in the development of improved equipment and preventive measures. The degree to which it was emphasized was indicated by the existence within the headquarters of the Air Forces and of USSTAF (United States Strategic Air Forces) of a special division of the Surgeon's office called the Division for Care of the Flyer. In further development of this interest, special Industrial Hygiene Control Officers were assigned to duty on the continent and in Great Britain. They were primarily concerned with the prevention of accidents and injury, and of occupational hazards peculiar to men of the air forces. It would appear that opportunity for material improvement in the future program of military preventive medicine rests in more intensive study and application of measures directed toward minimizing these occupational and personal health hazards.

Eighth Air Force.---The Eighth Air Force was the first major air force unit established in Great Britain, in early 1942. The usual separation of interests between prevention of disease and care of the sick and wounded did not exist in the organization of the Surgeon--as for instance in the Office of The Chief Surgeon, ETO, with its Division of Preventive Medicine and Division of Professional Services. However, there was no lack of emphasis in preventive medicine, and at least four divisions of the office of the Surgeon were concerned with this activity.

The Division for the Care of the Flyer has been mentioned. The Division of Professional Services had general responsibility for plans in the control of communicable disease and for supervision of venereal disease control. The Division of Medical Inspection dealt with problems of sanitation and with administration of the program for control of communicable diseases, including the venereal diseases. An independent Division of Nutrition indicated the stress given this important field. Responsibility in lower echelons fell to surgeons of the four separate commands making up the Eighth Air Force, with Composite Command more strongly staffed than others because of its isolated geographic position. In addition



to the permanent staff at the Eighth Air Force headquarters, additional personnel were assigned from time to time for special investigations such as the study of aerosols and of chemoprophylaxis in the control of upper respiratory infections.

The organization in 1944 remained much the same, with general supervision of preventive medicine affairs under the Chief of Professional Services. Venereal disease control, medical inspection and the care of the flyer continued as separate divisions.

Ninth Air Force.--The Ninth Air Force came to the European Theater from North Africa with a long, solid experience in field operations. Differing from the Eighth Air Force, whose military mission was strategic bombing from a fixed base, the Ninth Air Force was a mobile, tactical air force with the definite mission of furnishing support to the Allied invasion of Normandy, and thereafter close support to the various Armies of the United States. Its organization for preventive medicine was materially different from that of the Eighth Air Force, as demanded by the different character of its operations.

Based largely on its experience in Africa, a Hygiene and Sanitation Team was organized at Ninth Air Force headquarters. It consisted of a medical officer experienced in epidemiology, hygiene, and preventive medicine; an officer of the Veterinary Corps to be responsible for food inspection; and a Sanitary Corps officer trained in sanitary engineering. The duties of the team were "to insure supply and proper maintenance of adequate sanitary installations, disease control as well as insect and rodent control, on all occupied fields, camps, and stations, as well as proposed sites. The Hygiene and Sanitation Team will advise and assist all unit commanders as well as unit surgeons on all matters pertaining to public health. These include food in respect to supply, handling, storage, and preparation; the supply, transport and storage of water; messes and all mess equipment; waste disposal; and disease control." Similar teams were set up in the six commands which made up the Ninth Air Force, with similarly defined duties and organization except that they consisted of one medical officer and one sanitary engineer. This was preventive medicine in its best tradition of field practice.



United States Strategic Air Forces.--USSTAF was activated in 1944 as the superior air force headquarters of the theater. It had administrative control of the Ninth Air Force, operative control of the Fifteenth Air Force and administrative and operational control of the Eighth Air Force. In the office of the surgeon the Chief of Professional Services had supervision of all affairs concerned with the prevention of disease, including venereal disease control. A special Projects Officer was responsible for sanitation and review of the monthly sanitary reports. The Division for the Care of the Flyer was independent, as was usual in air force practice. The surgeon of the Base Air Depot Area had responsibility for the Division of Nutrition.

The integration of general theater policies and procedures with air force units was accomplished through this headquarters. In the case of the Ninth Air Force, perhaps because of its geographic location on the continent and its close association with the ground forces, there were numerous informal consultations and brief tours of field duty by officers in preventive medicine from theater headquarters.

Air Transport Command.--The Air Transport Command would seem to have greater organic need for preventive medicine than most other branches of the service. The far flung and changing character of its operations brought multiple and complex exposure to communicable disease, its occupational hazards were numerous, and its activities were of necessity often conducted under conditions of extemporized and deficient environmental sanitation. In the ETO, its measure of accomplishment in preventive medicine was scarcely that of other parts of the Air Forces. In too many instances, it had difficulty in meeting minimal requirements.

The part which the Air Transport Command took in developing improved measures for control of international air traffic was of importance to the welfare of the theater as a whole. What eventually became the standard operative procedure for control of aircraft entering and departing from the theater was a joint development of surgeons of the Air Transport Command, the Eighth Air Force and the Chief Surgeon, ETO.



## FIGURES

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2. Map of United Kingdom showing boundaries of base sections, Services of Supply, 1943.
3. Map of Western Europe showing boundaries of advance and base sections, Communications Zone, 1945.





A HISTORY OF PREVENTIVE MEDICINE  
IN THE  
EUROPEAN THEATER OF OPERATIONS  
UNITED STATES ARMY  
1941 - 1945

PART III - Epidemiology  
Section I - Introduction

by

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## PART III Epidemiology

### Section I - Introduction

Organized effort in preventive medicine, whether it be civilian or military, quite apparently extends well beyond the prevention and control of the communicable diseases; and yet in the final analysis that is the primary obligation of any health department, of any military organization in preventive medicine. The first health problems encountered in the European theater were in epidemiology. Work in this special field took shape in advance of others, and perhaps first attained formal organization and satisfactory performance.

Policies and Functions.—Certain major objectives and aims designed to govern activities in the control of the communicable diseases, were prescribed in a statement of policies formulated shortly after the Epidemiology Branch was established in the Division of Preventive Medicine at theater headquarters. Intended primarily to guide action at this higher level of authority, they were nevertheless applicable throughout the fabric of the Medical Department. In detail, they were as follows: (1) Preparation of comprehensive plans and procedures for the control of the acute communicable diseases commonly existing in the European Theater of Operations; and for those likely to be introduced through military action or other abnormal activities incident to war. (2) Provision to unit, base section, ground force, and air force surgeons of advice, consultation, and specific information on particular problems associated with epidemic or endemic situations. (3) To furnish the technical aid of qualified epidemiologists for the investigation and control of epidemics that had developed or might develop beyond the facilities of a particular unit. Preliminary surveys will be made by a staff member of the Epidemiology Branch at theater headquarters. As circumstances demands, epidemiologic teams of medical officers, public health nurses, and laboratory technicians will be designated from the staff of the medical general laboratory. (4) To prescribe an adequate program for specific immunization against those communicable diseases for which such measures exist; and to control by inspection, survey, and report, the satisfactory accomplishment of that program. (5) To extend knowledge and to improve methods for the control of epidemic disease, through continuous investigation by all clinical, laboratory, and epidemiologic means available. In unusual circumstances and for unfamiliar diseases, special boards will be constituted to this end. (6) The collection of information and the institution of a system of records, charts, and graphs to permit analysis and interpretation of the current prevalence and incidence of the more important communicable diseases. This will include data on troops of the command, of the civilian population of the area occupied, and of the troops of allied armies. (7) To establish close cooperation and liaison



with civilian and allied military authorities, to the end of a full exchange of information on the incidence of the communicable diseases; and on methods and practices for the control of these conditions.

(8) To affect periodic interchange of information with the Office of The Surgeon General, Washington, on experiences and on scientific progress in the field of epidemiology.

Organization for the Control of Epidemics.—It is to be accepted as principle, that primary responsibility for the control of the communicable diseases rests with the unit surgeon. No one else has equal opportunity to recognize the beginnings of an epidemic and to initiate promptly and effectively the indicated measures for its limitation. The sole function of expert epidemiologists at more exalted levels of command is to furnish general rules for guidance, to keep unit surgeons informed of newly developed technics, to assure satisfactory distribution of current knowledge on the movements of transmissible disease, and finally, to lend a hand when the demands of a given situation are beyond local resources.

The unit surgeon serving with troops of the line, ordinarily called upon the division medical inspector for necessary aid in matters concerned with control of the communicable diseases. This principal assistant to the division surgeon had primary responsibility for all matters of health within the division area. He in turn consulted the medical inspector of Corps, who had supervisory action over assigned troops and direct responsibility for units attached to corps. The first organized division of preventive medicine in the ground forces was at Army level. An experienced epidemiologist was invariably a member of the staff. Matters of such interest or importance that other armies were concerned, were cleared through the preventive medicine division of the respective Army Group, which also extended a consultation service to armies within its jurisdiction.

The air force organization for communicable disease control resembled that of the ground forces. An epidemiologist was stationed at Air Force level, the work of the various Commands corresponded to that of Divisions in the ground forces, and overall authority was vested in the United States Strategic Air Force.

The third principal component of the forces comprising the European theater, the Communications Zone, had provision for epidemiologic consultation and aid through epidemiologists serving as staff members of all base section preventive medicine divisions. This service was available to all units within the base section area.

The epidemiologists at higher echelons, whether Base Section, Army or Air Force, brought into full play all services and installations having to do with epidemic control. They were in a position to elicit the help of the Corps of Engineers, if the problem was related to water supply, or that of the Quartermaster Corps if it chanced

to be one of insect control. Coordinated effort with local and theater laboratory services was assured.

Epidemiology at these major operational levels was field epidemiology. Epidemiologists gave direct and practical aid in bringing about control of a situation. (Fig. 1) Working with the local medical officers in the area involved, they surveyed the conditions underlying an outbreak. They gathered the history of the outbreak from its beginnings, visited commands and quarters from which cases had come, made spot maps of occurrence, traced contacts, investigated the relations of case to case spread, determined relations to water and food, and instituted laboratory studies to confirm their findings. The particular measures necessary to arrest an epidemic could then be formulated intelligently.

The division of Preventive Medicine of the office of the Chief Surgeon established epidemiologic policy, circulated information and aided in meeting emergencies. It confirmed technical examinations, reviewed reports of epidemiologic studies and the recommendations they contained, and gave advice. It contributed the experience and knowledge gathered by reason of familiarity with conditions throughout the theater generally. But the service provided by the organization at theater headquarters aimed at more than advice, -- or consolation or criticism. Provision existed for direct field aid in the investigation of outbreaks of communicable disease by members of the epidemiologic staff. This professional assistance was liberally used by many units, sometimes to accomplish preliminary surveys of a situation, with recommendations for a method of attack; sometimes as a long continued cooperative effort in problems of major concern.

Under circumstances where the causes of an epidemic or the reasons for its continued progression were particularly obscure, the special facilities of the First Medical General Laboratory were utilized. Adequate investigation of some outbreaks required highly specialized laboratory procedures; in other instances, the primary need was for appreciable numbers of experienced field workers. The benefit deriving from close coordination of laboratory and field studies was commonly evident, and many times imperative. Need for such special studies was in all instances determined by preliminary survey by epidemiologists from the theater office of Preventive Medicine. Request for study of the particular problem was made to the laboratory and they organized staff and equipment, and planned and executed the study. The results were transmitted to the Preventive Medicine division for administrative action, and for necessary recommendations to the Chief Surgeon and to the organization concerned.

Personnel in Epidemiology, Office Chief Surgeon.---A long term and continued development of activities under a single directing head characterized the work of most branches of the Division of



Preventive Medicine in the Office of the Chief Surgeon. The Epidemiology Branch lacked that advantage. Throughout the several years of the theater, it fell to the lot of the Chief of the Division to maintain a guiding policy in this important feature of preventive medicine and to provide the continuity between frequent changes in administrative responsibility.

During the early months of 1942, the conduct of epidemiological interests was a responsibility of the subsequent chief of the division, Colonel John E. Gordon, then acting as civilian consultant to the Chief Surgeon. Lt. Dean S. Fleming assisted in field work and was responsible for the general management of the office. From June through August 1942 the head of the Epidemiology Branch was Major (later Lt. Colonel) John W. R. Norton. With Lt. Fleming he left the theater in the autumn of 1942 for duty in the Mediterranean Theater. 2nd Lt. (later Captain) Edna M. Cree joined the Epidemiology Branch in September 1942, continued as a member of the staff until operations ceased in June 1945, and through the latter half of 1945, served with the Historical Division, collecting material and planning the content of this present history. The work was continued as a member of the Historical Division, Office of The Surgeon General until June 1946, her services thus extending from the earliest days to the very end.

With the departure of Major Norton and Lt. Fleming the supervision of epidemiological interests again came directly under the chief of the division and so continued until Captain (later Major) Claude M. Eberhart joined the staff in December 1943. During the intervening period assistance was furnished by a number of officers, including Captain Joseph T. Marshall, Lt. Lawrence Kilham, and various members of the staff of the First Medical General Laboratory who served on temporary duty from time to time, particularly Captain John Degen and Captain W. S. Spring.

When the Epidemiology Branch was transferred to the continent with the remainder of the division in August 1944, Captain Eberhart remained in Great Britain as Chief of Preventive Medicine for the United Kingdom Base. He continued his responsibilities for epidemiology in that important area until transferred to the Assembly Area Command in June 1945. Captain (later Major) Roger S. Whitney worked in epidemiology from 19 January 1944 until he left in May of that year to become epidemiologist with the Advance Section, C.Z. Major (later Lt. Colonel) Charles D. May served for a brief period in connection with epidemiological studies on pneumonia. Captain (later Major) W. L. Hawley joined the Epidemiology Branch in May 1944 and remained until May of 1945.

Lt. Colonel Arthur P. Long assumed direction of epidemiological affairs in the Division in August 1944, having been released from assignment to the forward echelon of the Communications Zone on inactivation of that part of the Office of the Chief Surgeon. He





Figure 1.

Field Epidemiology in Practice



left the theater in October 1944 to resume his previous position in the Preventive Medicine Service of the Office of The Surgeon General.

During the next several months, work in epidemiology again came under the direct supervision of the Chief of the Division until Lt. Colonel Richard T. Mason took over in February 1945 after a long and active field service in the Mediterranean Theater and subsequently with Soloc in southern France. He continued in this position until theater activities closed 30 June 1945 and shortly thereafter became acting chief of the Division of Preventive Medicine in the newly organized USFET. Captain William S. Brumage served as his principal assistant from May 1945, as did 1st Lt. William G. Good.

Much of the collection and analysis of records of disease prevalence was done by the enlisted men of the division. Conscientious service was rendered by many individuals. T/3 Richard H. Foote brought a sound scientific training to the position of chief clerk of the Branch. T/4 Norman E. Williams and T/3 John C. Ryzak were largely responsible for statistical analyses and the preparation of graphs and charts, many of which appear in this history of the work of the Division.

Reporting of Communicable Disease.--A well-organized system of reporting the communicable diseases is essential to satisfactory epidemiologic work. The conditions for this did not exist in the early days of the theater. Even toward the end of 1942, reporting could not be said to be either good or prompt. With units moving into the theater and out to North Africa, with information often lacking about the location of units within Great Britain, with indefinite information of total numbers of troops, it is understandable that reliable and current facts about the number and location of patients with communicable disease was often most indefinite.

Medical Records in the United Kingdom.--Throughout the history of the theater, a close working arrangement was maintained with the Division of Medical Records. Their routine weekly reports were rendered promptly, and more commonly than not, delivered by hand that they might reach Preventive Medicine at the earliest moment. More important than that, informal information about recent developments was exchanged almost daily. Access was had to their work sheets in advance of formal reports.

Because of the recognized lack of a satisfactorily functioning system, all sorts of sources of information were developed to increase current knowledge of the communicable diseases. An occasional bit of information was obtained from the routine sanitary reports. The daily admission and discharge records of hospitals were examined for communicable diseases. Arrangements were made with the Ministry of Health to obtain information about communicable



diseases affecting American military personnel, which came to that agency through reports from local civilian health authorities. British hospitals, not uncommonly advised of American soldiers admitted directly to those institutions. Knowledge of unusual happenings often came directly from base section surgeons through request for epidemiologic aid. Thus, from a variety of sources of varying reliability, information was gathered during this formative period in the theater's history which gave a working command of the frequency with which the communicable diseases were occurring.

Epidemiological work was greatly benefited during the year 1943 by the development of a better organized system of reporting; with the result that the Division of Preventive Medicine was able to accumulate more nearly complete records. The Division of Medical Records furnished weekly consolidated statistical reports of admissions to hospitals and quarters. Perhaps most valuable of all were the direct weekly reports to the Division of Preventive Medicine by base surgeons, a system instituted early in 1943.

The health of United States forces in a theater of operations is inevitably associated with that of the civilian and other military populations of the country where it is located. The office of the Chief Surgeon kept abreast of disease trends in the United Kingdom by means of the weekly reports on infectious diseases furnished by the British Ministry of Health, and through the reports of the British war office.

Medical Records in Continental Europe.---The many months in the United Kingdom had led to a situation whereby a very satisfactory system of medical records had eventuated. Information came readily to hand, sufficient for the needs of most epidemiologic problems. When operations started on the continent, conditions were materially different. The relatively static sort of existence no longer held. The conditions that presented were those of active military operations, with field armies largely concerned, and with most of the troops on the move. Reliable medical records were much more difficult to obtain, and their assembly and tabulation infinitely more complicated.

The probability of such a situation had been appreciated in the preliminary planning for continental operations. Discussions were held early in 1944 between the two divisions concerned, those of preventive medicine and of medical records, with the purpose of determining the minimal requirements for sound epidemiologic practice, and to eliminate all non-essential information.

To facilitate the program, the Medical Records Division sent a small detachment to the continent in August 1944, while the main part of the division remained in the United Kingdom. The first consolidated reports furnished by the detachment were as of 7 September 1944. This event will explain a number of the tabulations to follow, in that satisfactory records of continental experience in many instances date from these reports.

In the course of continental operations, epidemiologic data were derived from several sources of information. Principal reliance was placed on the weekly consolidations of the Statistical Health Report, WMD Form 86 ab, 24 January 1944. All infectious disease from units, treated as such in quarters or in hospital was reported on this form. Knowledge of hospital cases also came from Form 310 MDETO, a report peculiar to the European theater. Total cases of a given communicable disease were obtained by the summation of data from these two sources. MDETO Form 323, a report used only by field armies, was of great advantage in epidemic situations involving the ground forces. (Fig. 2) It served in a particularly useful capacity during the outbreak of trenchfoot in November and December of 1944. Special information related to contact tracing, as a measure in venereal disease control, was obtained through MDETO Form 302, a report designed to fill that particular need. Unusual outbreaks of epidemic disease, or the occurrence of uncommon and particularly serious infections were reported by telephone or telegram by base sections of the communications zone, by armies and by air forces. Information concerning communicable disease in the French Ministry of Health after the occupation of Paris in September, 1944. At best, the data were fragmentary and unreliable. The French reporting system had been disrupted and the chaotic state of communications introduced other difficulties. More valuable information on the state of civilian health was ordinarily obtained from the special reports and the regular monthly summaries issued by the Public Health Section of G-5, SHAEF.

Through early contact with the Office International d'Hygiene Publique, information became regularly available about communicable diseases in French ports, and internationally from countries with which that agency continued in contact. Pertinent information on outbreaks of disease in enemy territory and in forward areas under our control was often furnished by G-2 staff sections of armies, through interrogation of prisoners of war.

Medical Records for Epidemiologic Use. --The system of medical records in the U. S. Army was designed to meet a variety of needs. The present comments relate only to the use they were put in the conduct of epidemiologic affairs in the control of the communicable diseases, and the extent to which they adequately served that purpose.

Principal reliance was placed on the Form 86 ab, Statistical Health Report. That it failed to meet the complete need has been brought out by the numerous measures that were taken to supplement the information provided. The Statistical Health Report is a consolidated report. The main shortcoming was therefore the inability to identify an individual infection in terms of the name, unit and location of the person affected. This was essential to case study, and case study is the principal reliance in the control of unusual or particularly serious diseases such as typhus, typhoid and many others.



The delay inherent to submission of a periodic consolidated report, in this instance on a weekly basis, meant that the promptest reporting was a matter of seven to fourteen days after the event occurred. A fast moving epidemic such as influenza could reach critical height before it became evident in statistical reports.

Lack of identifying data made it impossible to eliminate duplicate reporting by unit and by hospital. Prisoners of war, allied military personnel and civilians treated in U. S. Army hospitals often could not be separated from military personnel; with the result that the estimated current incidence of a given disease was invariably greater than fact, but to an indeterminate extent.

The nature of many illnesses was first determined after admission to hospital and reported by Form 310. No indication was available in such instances as to the unit of origin of the case, which was the critical feature epidemiologically.

Serious consideration should be given to introduction into Army practice of a comprehensive system of individual case reporting.

Provisional Health Data.---Principal attention has thus far been devoted to the difficulties of theater headquarters in obtaining adequate information about health affairs in the various units of the command. These troubles were reciprocal. The existing military situation and the vagaries in communications combined to make transmission of epidemiological information to units in the field during continental operations unreliable and unsatisfactory. A great part of the difficulty came from the fact that the Medical Records division was in Great Britain. Cross channel communications were particularly bad.

To remedy the deficiency, the Division of Preventive Medicine at theater headquarters instituted on 1 January 1945 a brief weekly report containing essential data on disease, battle casualties and non-battle injuries. A second part of the report was devoted to epidemiologic notes arising from interests of the preceding week, and to brief interpretation of the statistical data presented.

This little mimeographed bulletin, with the title, Provisional Health Data, was prepared from information submitted each week-end by the continental detachment of the medical records division. The data were those forwarded by units as of the previous week which ended Friday midnight. Effort was made to get the bulletin into the mails on Mondays, with the result that the information reaching surgeons of the theater was not more than ten days old. It was distributed informally to the surgeons of all major commands, where in some instances it was reproduced for unit distribution. The promptness of its appearance compensated for its incompleteness and its provisional nature.





Figure 2.

Collecting Medical Records in the Field



Data Included in the History of the Theater.—Practically all of the data concerned with the analyses presented in this and in subsequent sections of the history of preventive medicine in the European theater are derived from the Statistical Health Report, WMD Form 86 ab, 24 January 1944. The tentative nature of this information and the inaccuracies it contains are recognized. It is the only information available at this time. The final data to be obtained through tabulation of WDAGO Forms 8-26 and 8-27 (Individual Medical Records) will form, when available, the authoritative and final basic record.





## FIGURES

Fig. 1. Field Epidemiology in Practice.

Fig. 2. Collecting Medical Records in the Field.





A HISTORY OF PREVENTIVE MEDICINE  
IN THE  
EUROPEAN THEATER OF OPERATIONS  
UNITED STATES ARMY  
1941 - 1945

PART III - Epidemiology

Section 2 - Intestinal Infections

Number 1 - The Diarrheas and Dysenteries

by

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### PART III Epidemiology

#### Section 2 - Intestinal Infections

##### Number 1 - The Diarrheas and Dysenteries

Despite the catastrophic results that may follow in the wake of an epidemic of influenza, or of typhus fever or cholera, "the plagues of field and camp" have come to signify more than anything else the troubles that arise from diseases associated with infection of the intestinal tract. American military history substantiates this fully. No less than 1,755,889 soldiers of the American Civil War suffered from acute and chronic diarrhea and dysentery. The number who died from these causes was 46,277. The annual attack rate for white troops during the period May 1861 through June 1866, was never less than 494 per thousand per year and for 1863 it was 850 per thousand per year. The annual death rate was likewise inordinately great; in 1865, 21.29 deaths per thousand per year.

The overwhelming importance of typhoid fever in the Spanish-American War served to overshadow the importance of the diarrheas and dysenteries. Nevertheless the number of patients with these conditions, including gastro-enteritis, was 204,040. The admission rate to hospital was 426.0 per thousand per year and the mortality was 3.3. (Table 1)

The greatly improved environmental sanitation which came with the turn of the century paid dividends in World War I. Deaths from diarrhea and dysentery were less than in any previous major conflict of which there is record. The prevailing rates showed the variations characteristic of the alternating conditions under which military operations are conducted, but a direct relation could ordinarily be established between incidence and the efficiency with which sanitary requirements were carried out. The marked improvement shown by this experience over all others is best demonstrated by the mortality rate for the period of World War I, which was 0.13 per thousand per year. The gain in comparison with the Spanish-American War was overwhelmingly greater than that which the Spanish-American War showed over the Civil War. A similar ratio held for reported cases.

World War II continued this trend, to the extent that only four deaths from diarrhea and dysentery of all forms were reported for troops of the European Theater of Operations; and the mortality rate was 0.00126. Attention in subsequent discussion will be given to the identity

of those particular intestinal infections exerting the greatest influence in bringing about this general improvement. The causes of decreased rates will be considered in some detail, together with the nature of the preventive measures which conceivably may lead to still greater improvements.

Classification of Intestinal Infections.--The consideration of the disease conditions ordinarily included within the group of intestinal infections will be in accordance with the separation made by the Statistical Health Report. The following are recognized:

1. Bacterial food poisoning
2. Common diarrheas
3. Dysentery, bacillary
4. Dysentery, amebic
5. Dysentery, unclassified
6. Paratyphoid fever
7. Typhoid fever

During the first two years of operations in Europe only six categories were distinguished. Bacterial food poisoning was added when the statistical health report, Form 86ab of 22 August 1940, was revised in 1944. This term will be understood to refer to cases of abrupt onset and short duration, characterized by vomiting and diarrhea, and occurring simultaneously in groups of individuals who have all consumed the same suspected food or drink. Cases of bacterial food poisoning previous to 1944 were presumably included under common diarrhea. Undoubtedly a considerable proportion continued to be so reported, because the numbers of cases listed under bacterial food poisoning in the tables to follow can by no means be considered as inclusive, based on first-hand knowledge of what actually took place.

The above circumstance is illustrative of the extent to which differences in nomenclature, and styles in diagnostic terminology make difficult a satisfactory comparison of the experiences of one war or of one period of time with another. Medical criteria for diagnosis likewise change with the years. Current statistical information on typhoid fever and paratyphoid fever can be accepted as reliable, since in modern practice diagnosis depends almost universally on satisfactory identification of the specific infectious agent. The same observation applies to amebic and bacillary dysentery in United States Army practice, since identification of the responsible pathogen is by regulation requisite to these diagnoses. But these conditions have not always held, and they do not always hold now. Laboratory confirmation was commonly impossible under combat conditions, with the result that by far the greater



number of dysentery reported in the European Theater fell within the group designated as unclassified etiologically. The diagnosis was clinical; and cases may have been true dysentery or they may have been instances of severe and prolonged food poisoning or of common diarrhea.

The common diarrheas include a variety of gastro-intestinal infections of unknown cause. The use of this single inclusive term is believed to have a material advantage over the practice of previous years in applying a number of inexact anatomic diagnoses to a group of diseases about which too little is known. Disease conditions designated enteritis, colitis, enterocolitis and gastro-enteritis are here classed collectively as the common diarrheas. Also included are instances of diarrhea (cause undetermined) and fermentative diarrhea, intestinal indigestion and intestinal toxemia, when associated with diarrhea. The clinical character of these conditions makes it certain that a proportion of cases included in the category of common diarrhea may well have been dysentery, and conversely that a number of cases reported as dysentery might better have been called common diarrhea, had a strict etiologic classification been possible. However, a broad distinction between the group of common diarrheas and the group of dysenteries, including those registered as unclassified, appears valid on the basis of general clinical differences.

A further consideration which complicates attempted comparison of the current experience in the European theater with that of other wars, is the fact that data of this war include all patients reported as suffering from a given condition, irrespective of whether they were sick in quarters or admitted to hospital. Previous information from United States Army sources was often limited to hospital admissions. This is a consideration of little consequence in relation to typhoid fever and to a large extent with the dysenteries, since practically all patients go to hospital. The common diarrheas are wholly another matter. No worthwhile estimate can be made of the proportion of patients in the European Theater who were sick in quarters, and those who were admitted to hospital. The relation would certainly vary according to the severity of a given outbreak. However, the present data may be exaggerated by inclusion of both hospital and quarters patients. This factor is to be considered in comparing the present experience of the European theater with that of previous wars.

The general level of reporting was also undoubtedly much better. In times past, intestinal infection came to be considered as more or less a normal accompaniment of military life. With increased rarity of these conditions, an intestinal infection became a matter of more concern and soldiers were more likely to attend sick call, and to enter hospital. The improved standard of medical care contributes to the same general result. It is not to be concluded, however, that present day reporting of common intestinal complaints is by any means good. It is simply better.

The numbers coming to official report still represent a relatively small proportion of actual occurrence.

Even if data on hospital admissions for diarrhea and dysentery were available for the European Theater, the comparison with previous experience of the United States Army would not be wholly valid, because of the very different interpretation given in the course of time as to just what was a hospital and just what constituted a hospital admission.

For these several and diverse reasons, comparisons of eras and even of areas at a given date must be on a broad and very general basis. No more than relative differences can be shown.

A Basis for Comparison of Experience.--Comparisons of the behavior of the intestinal infections would seemingly best be accomplished by consideration of two groups. The first and larger group will include all infections of indeterminate and undetermined cause, the common diarrheas, and it will be treated as a group. The members of the smaller group will be considered individually, since they represent diseases of specific etiology and reliable clinical diagnosis. The general term of diarrheas and dysenteries will be interpreted to include all of the dysenteries - amebic, bacillary, and unclassified - and the loosely defined aggregate of the common diarrheas. Bacterial food poisoning, which became reportable in 1944, typhoid fever and the paratyphoid fevers are not included.

Using this broad generic grouping of all the diarrheas and dysenteries, the relationship between the experience of various major elements of the forces of the European Theater can be determined with relative exactness. The explanation of demonstrated differences in rates can be sought in varying epidemiologic factors. Since systems of reporting and criteria for diagnosis are fairly uniform throughout the United States Army, the differences in rates between theaters may be measured with some certainty. Such a basis of comparison is not necessarily unscientific nor illogical, considering the present situation of etiologic uncertainty for many of these diseases, and the inability under field conditions to determine specific cause where methods are available. All of these diseases are transmitted by the same general means, through ingestion of food or drink. The underlying predisposing causes and the indicated preventive measures are much the same, irrespective of differences in specific etiology of individual cases. This would not hold true in like degree in comparing experiences of American and Allied armies in the same field of operations because of differences in classification and variation in standards for diagnosis.

The Diarrheas and Dysenteries.--The anticipated frequency of this group of diseases in military practice is measurably greater during active



operations in the field than under peace-time conditions, with due consideration given to periods of maneuvers when conditions simulate those of campaigns. The nature of the terrain, the climate, the habits of civilians within the area of operations, the level of environmental sanitation, the character of military operations, all act in determining the average level of rates for an army in the field. An army in training in the zone of the interior likewise meets a different situation than that characteristic of seasoned veteran troops in time of peace.

As a basis for judging the experience of United States Army forces in the European Theater of Operations in respect to the diarrheas and dysenteries, the rates for troops stationed in the United States are set forth. They represent three different sets of circumstances, those of the peacetime army at home, of the mobilization of an army for war, and of the training of newly inducted recruits for service abroad.

Experience of the Peace-time Army.--The years immediately preceding preparations for war and the war itself may be considered representative of good average accomplishment for the United States Army. It is a record which compares favorably with that of any army. (Table 2) The period includes the years 1935 to 1939, and data are limited to troops stationed within the continental limits of the United States.

The rates were remarkably uniform, with annual variations from 2.5 per thousand strength per annum to 3.6, and an average for the period of 3.0. Seasonal variation was consistently emphasized, with low rates in the winter months and an increase in the spring. The maximum level was attained in summer, August being the chief month.

Preparations for War.--The rapid aggregation of large numbers of untrained men, the active field training they underwent, and the participation of large units in maneuvers led to a greatly increased overall incidence of diarrhea and dysentery for the pre-war period of 1940-1941, 13.0 cases per thousand strength per annum. (Table 3) This rate was in excess of that for domestic troops of the actual war period which was 9.5 per thousand per year. The incidence during the North Carolina maneuvers of August and September 1941 was greater by far than that for any single month of operations in Europe. The rates for these two months, 35 and 37 per thousand per annum, are to be compared with the maximum monthly rate in the European Theater of 28, in May of 1943. The annual rate for 1941, 15 per thousand per annum, is not far different from the year of greatest incidence in the European Theater - 17 per thousand in 1942. The troop strength in the theater was small and operations were just starting in an unfamiliar country.

The War Years in the United States.--The incidence of the diarrheas and dysenteries for troops of continental United States was



measurably less during the war years than in the pre-war period. (Table 4) Training and reception of raw recruits continued with increased activity. The large scale maneuvers were lacking. Nevertheless, it would appear that army procedure and army methods in prevention must have stabilized, for the general rate for this period of the war was 9.5. The usual seasonal fluctuation was evident. Some few months had an excess incidence beyond seasonal expectation, that of 26 per thousand in July 1943 being the greatest. This particular situation also suggests a relation to the unprecedented concentration in August and September of that year of a number of major outbreaks of common diarrhea on board transports bringing troops to Europe. The circumstances are described on page 23.

Of the four years included in this period the rate for 1943 was highest, a time when large number of troops were in course of training and shipments to theaters of operations were frequent.

#### Diarrheas and Dysenteries in the Several Theaters of Operations.--

In the course of the war, the United States Army extended its activities to eight different theaters of operations. They very nearly included the globe. All manner of conditions and climates were encountered. The epidemiologic factors which influenced the incidence of the diarrheas and dysenteries were so variable and so different that simple comparison of annual rates is without value. The analysis involved in a fair comparison is beyond the present interest.

The data for the four war years in the various theaters of operations are therefore set forth merely as an index of the relative seriousness of the intestinal infections in these several spheres of activity. (Table 5) The best rates were obtained in the Alaskan Theater, better even than for troops stationed in continental United States. The record of the European Theater was next in order. If comparison be based on troops occupying foreign territories, its record heads the list. The highest recorded rates were those holding for the Asiatic Theater. The striking and progressive improvement demonstrated by the Mediterranean and Middle East Theaters gave proof of the possibilities of preventive medicine.

The Experience in the European Theater, 1942 - 1945.--The average annual rate for the diarrheas and dysenteries for the United States Army in Europe was 14.0 per thousand strength per annum. This was greater by about one-half than comparable data for troops stationed in continental United States. The rate for domestic troops was 9.5 per thousand per year. The record that was established in the course of European operations constituted a creditable performance under field conditions, and gave evidence of the sound basic training of troops. (Table 6)

The lack of variation between annual rates from year to year was an outstanding feature. The rate of 17 during the first year in the United Kingdom was the highest in the history of the theater, but it was not greatly in excess of the average for the war period. The number of troops was small, conditions were unsettled and measures relating to environmental sanitation were in the course of development. The record for 1943 was excellent, almost identical with that for troops of continental United States. The increased rates that occurred when the Army took to the field in the invasion of France were considerably less than had been anticipated. The rate for 1944 was 12.7. For the first six months of 1945 it was 15.6. No outstanding difference existed between the rates experienced by troops serving in the United Kingdom base, and those which presented during the very active war of movement which characterized the European campaign. Much of the credit for the favorable rates on the continent was undoubtedly due to the strict prohibition on eating in civilian establishments.

The record of American troops in France in this war compared very favorably with that of the American Expeditionary Force of 1918, (Table 1) when the rate was 28.9. The difference becomes strikingly great when it is recalled that the European Theater data of 1944-45 represent all patients reporting ill, while those of the American Expeditionary Force include in the latter half of 1918 only the more seriously ill who were sent to hospital.

The relatively inconsequential part which the intestinal diseases had in relation to the general disease rates for the theater is shown by the fact that the diarrheas and dysenteries were responsible for only 2.6 per cent of total disease from all causes.

Intestinal Infection During Operations in the United Kingdom.--  
Material differences in the frequency of intestinal infection could be demonstrated among the three major forces of the command during the period when operations were limited to the United Kingdom. The Services of Supply maintained consistently higher rates than did the Air Forces and Ground Forces. (Figure 1, Table 7).

The cases which determine rates for the diarrheas and dysenteries in a military command come from two sources. The first group includes the more or less continuously appearing sporadic and isolated infections which determine the minimum static level of incidence characterizing a military population. The second increment is made up of groupings of cases constituting epidemics of varying size and accounting for the peaks in curves of incidence. The frequency and size of these outbreaks eventually determine whether the complete experience is good or bad.

Under conditions existing in Great Britain sporadic intestinal upsets were to a large extent associated with eating and drinking in



civilian establishments. Actual outbreaks of diarrhea, on the other hand, were almost always due to faulty messing practice within the unit.

The principal factors which operated in causing food-borne outbreaks were the use of left-over foods, preparation of foods too long in advance of serving, and failure to maintain minimum sanitary standards in messes. Other contributing factors influenced these major faults either singly or in combination. They were lack of refrigeration for food storage, inadequate stove space in relation to number of rations prepared, undue use of custards, puddings and creamed foods in mess planning, failure on the part of mess personnel to properly plan meals in regard to amount of food, palatability of the food that was served, and an intensive food conservation program which resulted in wide use of left-over foods.

Reference to Figure 1 will show that the fewest peaks (food-borne outbreaks) occurred in the trend line that relates to the Air Forces, where in general the mess management and mess personnel were more adequate, and where less attempt was made to conserve food. The minimum static level of the curve (sporadic cases) was also low, since Air Force stations were relatively isolated and personnel had little opportunity to patronize civilian eating establishments except on pass or furlough.

The Ground Forces had a greater number of food-borne outbreaks than did the Air Forces, some of which were of relatively large scale. This was due to all of the listed contributing factors being operative until marshalling exercises began, an actual concentration of troops in marshalling areas took place in the late spring of 1944. As a result of the special emphasis then placed on proper mess management, and the provision of more adequate mess equipment, major food-borne epidemics were largely eliminated. This is reflected in the consistently declining trend of the curve of incidence for Ground Forces after February.

Although Services of Supply troops for the most part had the advantage of permanent messes, they were handicapped by a particularly intensive food conservation program and a poorer type of mess personnel. The prevention of food wastage was emphasized in Services of Supply units more than in any of the other forces. The result was that foods which had been prepared in excessive amounts were stored and served again several hours later. If refrigerated storage had been generally available, this practice would have not constituted a special hazard. In the European Theater, where refrigeration was not commonly available, the practice of saving left-over puddings, custards and creamed foods for any appreciable time, and cooked meat dishes for more than six hours, accounted for about one-half of the traceable food-borne outbreaks.

Mess duty in units of the Services of Supply was not as attractive as in the other forces. In a Ground Force organization, mess personnel did not engage in the more rigorous phases of training or combat, and in



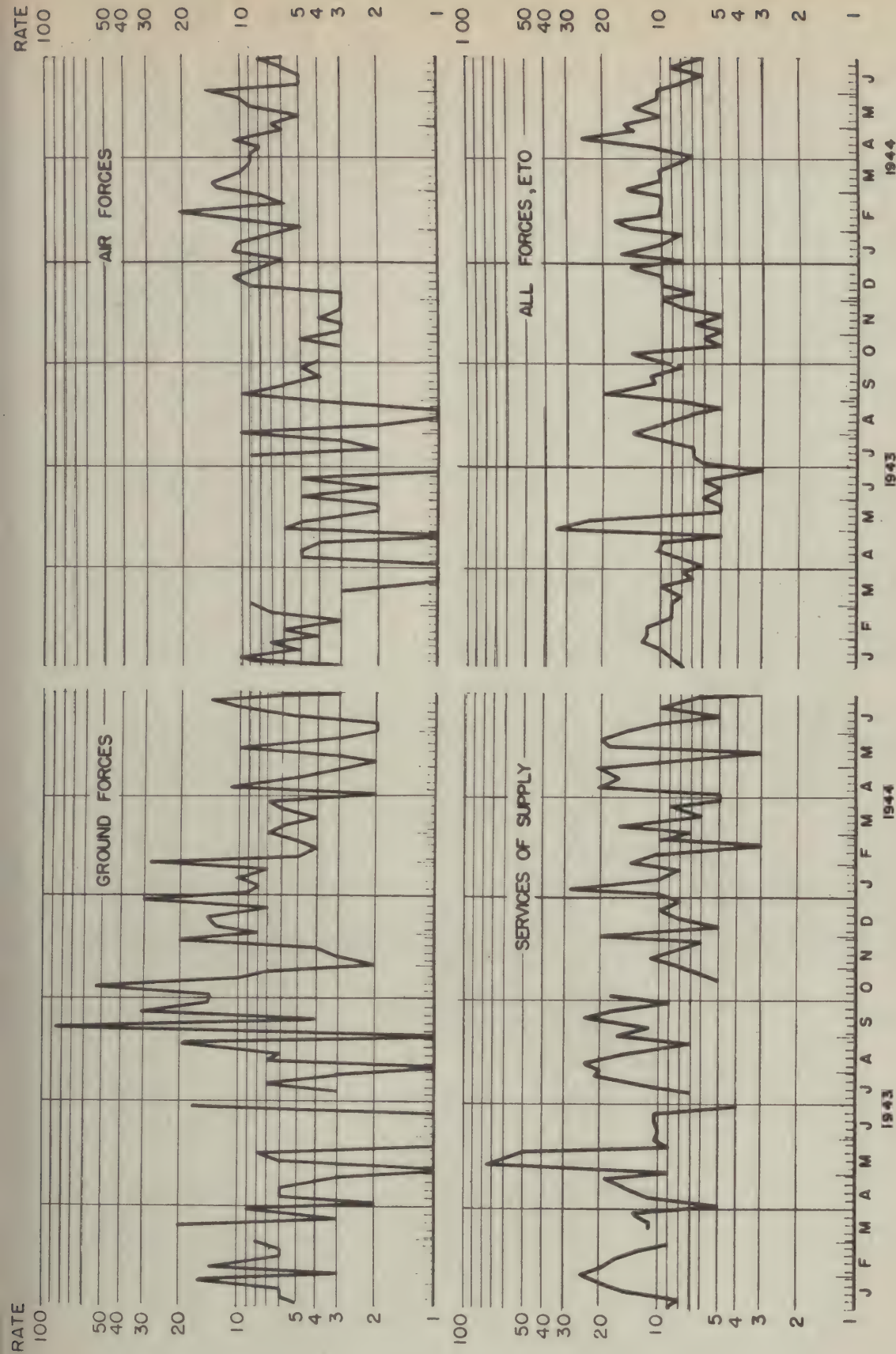


Figure 1

Intestinal Infections, Including Common Diarrheas and Dysenteries, All Forces, and Communications Zone, United Kingdom, Rate per 1000 strength per annum by weeks, 1 January 1943 to 30 June 1944.



the Air Force they did not have to participate in the long gruelling periods of work under pressure on the line or take part in extremely hazardous combat missions. Hence, for certain types of men, mess duty in these forces was coveted and they strived to do an excellent job. In the Services of Supply, mess duties entailed more confining work over longer hours than most other assignments, and therefore was less desirable than ward work in a hospital, office clerical work, driving, or even depot supply work. In view of this difference, it was reasonable to believe that Service of Supply mess personnel took less pride in their work and made less effort to adapt themselves. This was observed in many instances. Short cuts in mess practice were common, such as the early preparation of foods during slack periods without regard to the time of serving, and the extensive use of left-over foods particularly when it was known that an admonition would be administered if excess food was discarded.

The combination of these factors was reflected in the curve of diarrheal incidence in the Services of Supply, which had more peaks (food-borne outbreaks) than either of the other two forces. It was characteristic of all individual base sections. The minimum static level of the curve of incidence for all Services of Supply troops was influenced by the regularly prevailing high rates of the Central Base Section. That was due to the relatively great number of sporadic cases that occurred among troops in the London area through patronizing civilian eating and drinking establishments.

Intestinal Infection During Continental Operations.--The transition from a long static existence at a base of operations to a condition of decidedly active operations in the field led to certain alterations in the relationship of the three components of the command in respect to the dysenteries and diarrheas. (Figure 2, Table 8) The general rates of the theater increased somewhat, but not greatly. (Table 5) The increment was due to an increased frequency of these diseases among troops serving on the continent, with contemporary rates for troops stationed in the United Kingdom remaining essentially unchanged. (Figure 3, Table 9)

The Air Forces operating on the continent maintained their same relative position (Figure 1, Table 7) in respect to the two other forces, with rates that were materially lower. Air Force troops in Europe were represented principally by the Ninth Air Force, a tactical organization operating under field conditions. Although three fair sized peaks (epidemics) and a number of minor ones were introduced into the curve of incidence in the course of the year on the continent, the minimum static level was decidedly good and the overall experience compared most favorably with the rate for continental troops as a whole during the same



time interval. It is likewise worthy of note that this tactical unit on the continent fared very well in comparison with troops of the Eighth Air Force who remained in Great Britain. By 1945 the Eighth Air Force had become firmly established in fixed stations with presumably well stabilized living conditions. The mobile wandering Ninth in the course of its support of Armies, accomplished a rate that was equally good. (Figure 4, Table 10)

The Ground Forces went through some of the most difficult days of the European campaign with rates for the diarrheas and dysenteries that were almost unbelievably good. The diarrheal disorders were certainly not frequent, in fact their general absence was a matter of comment. As an indication of actual incidence, the recorded rates are likely less reliable than usual, because the reporting of communicable disease in those early days of the operation was decidedly irregular. One important consideration must not be discounted. During the first part of the campaign, troops of the command were on C and K field rations, which is a first-class preventive against food-borne disease. As the diet became more complicated through the eventual introduction of Class B and Class A rations, the opportunities for contamination of food were increased, and the rates for diarrheas and dysenteries were greater.

Beginning the latter part of September, a general wave of epidemic diarrhea involved most of the field Armies (See page 19). This is reflected in the progressively increased rates which reached a peak of 38 per thousand per year for all Ground Forces during the week ending 15 December 1944. Thereafter conditions were somewhat better except that January and February saw continued high rates, in the neighborhood of 25 per thousand, during the active fighting and the war of movement which characterized those months. With the break-through into Germany in late March, the situation was both stabilized and improved, with successive weekly rates being much the same and averaging about 13 per thousand per annum until operations ceased.

With the exception of brief periods in December, January, and February, the Communications Zone rather continuously maintained the same leading position in respect to rates for the diarrheas and dysenteries that it had established in the United Kingdom. During the summer months of 1944 presumably the same influences acted as had in the case of the Ground Forces, for the record then was decidedly good. Neither the Ground Forces nor the Communications Zone troops ever again approached such favorable levels. Only the Air Forces continued to go along on a fairly even keel.

The performance of the Communications Zone was most uneven, being punctuated by repeated sharp variations in rates indicative of extensive local epidemics. The contrast with the Ground Forces was well marked. That branch of the service experienced a gradual and well-defined upward

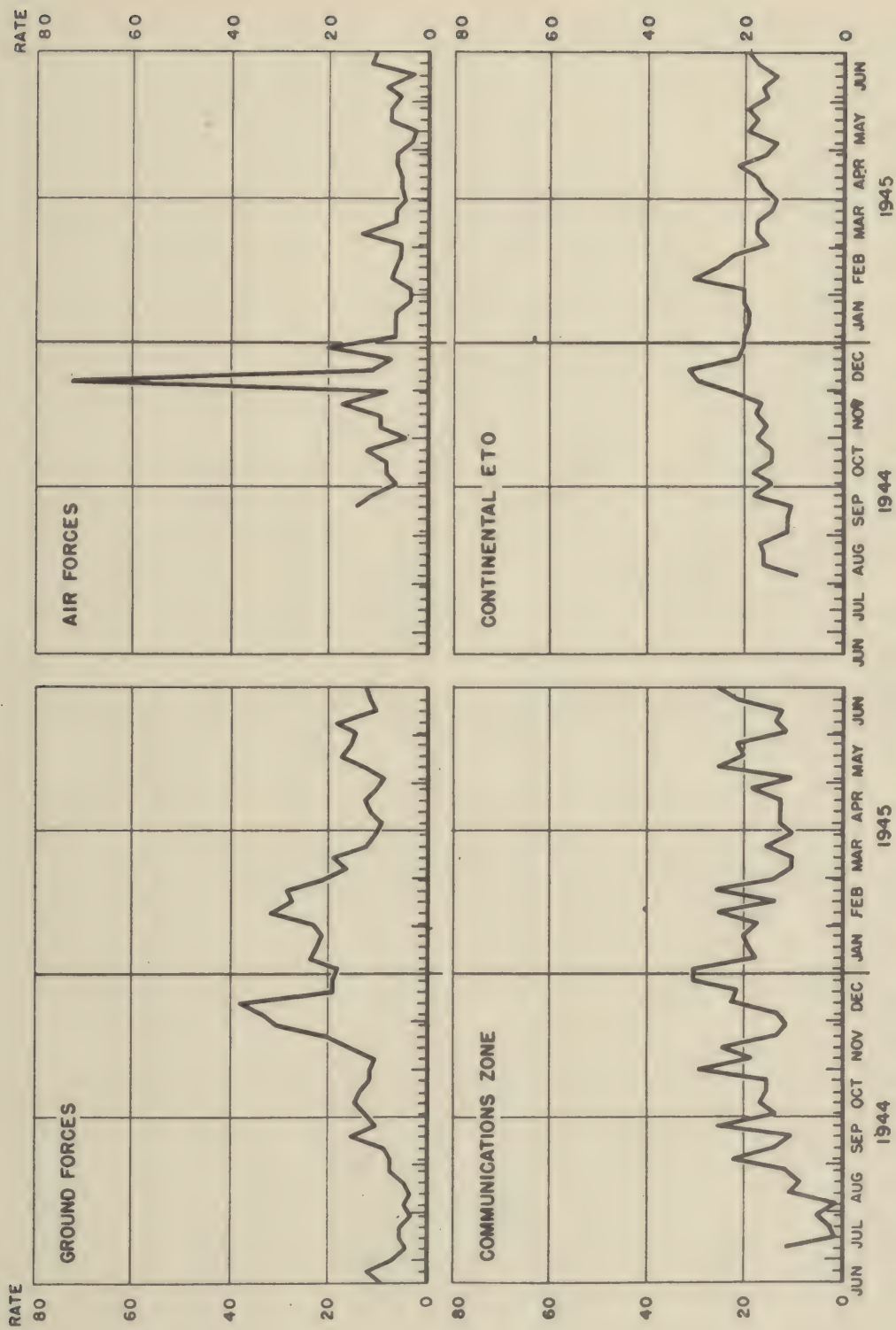
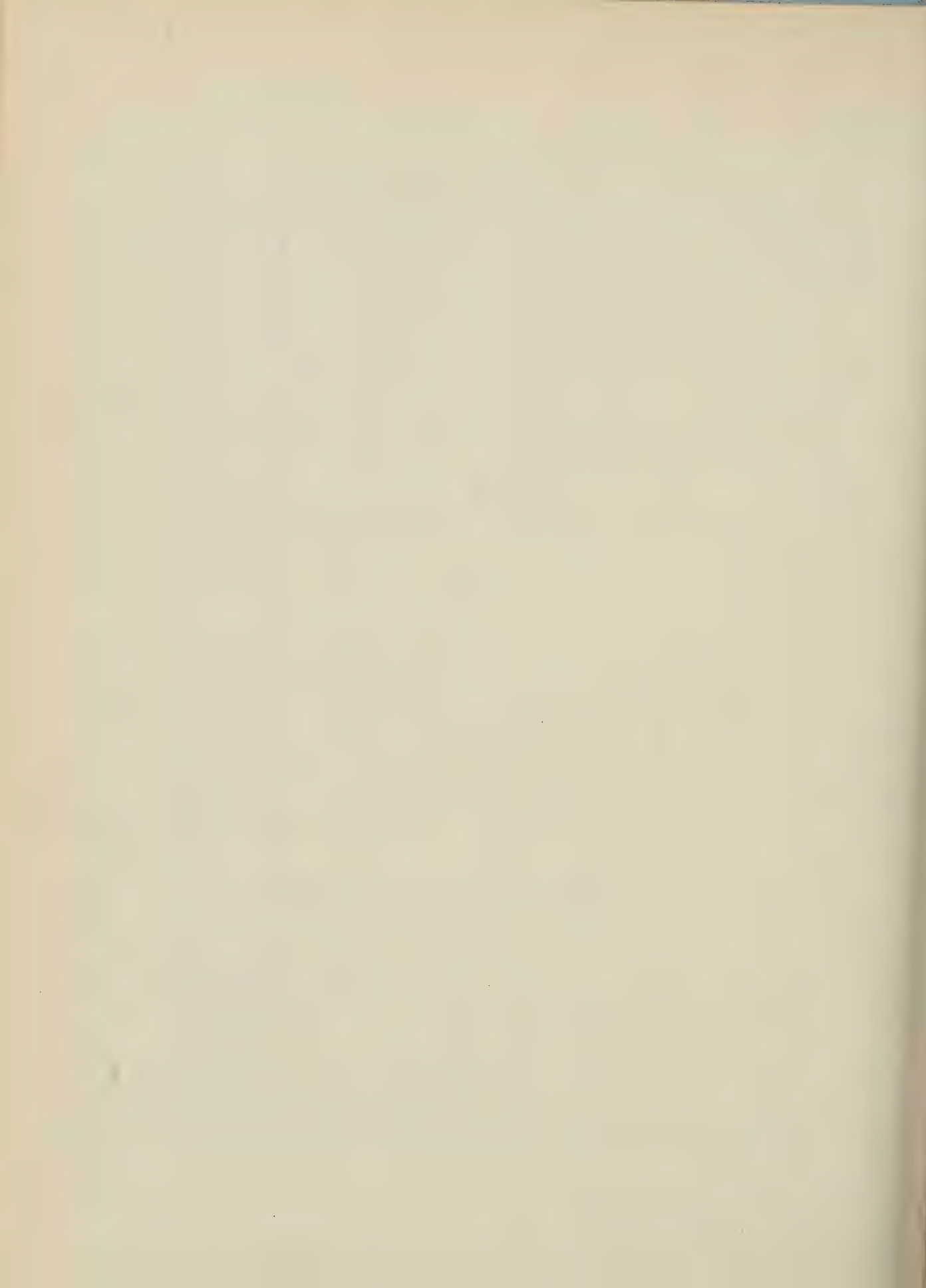


Figure 2

Intestinal Infections, Including Common Diarrheas and Dysenteries, All Forces, Ground Forces, Air Forces, European Continent only, Rates per 1000 strength per annum by weeks, 23 June 1944 to 29 June 1945.





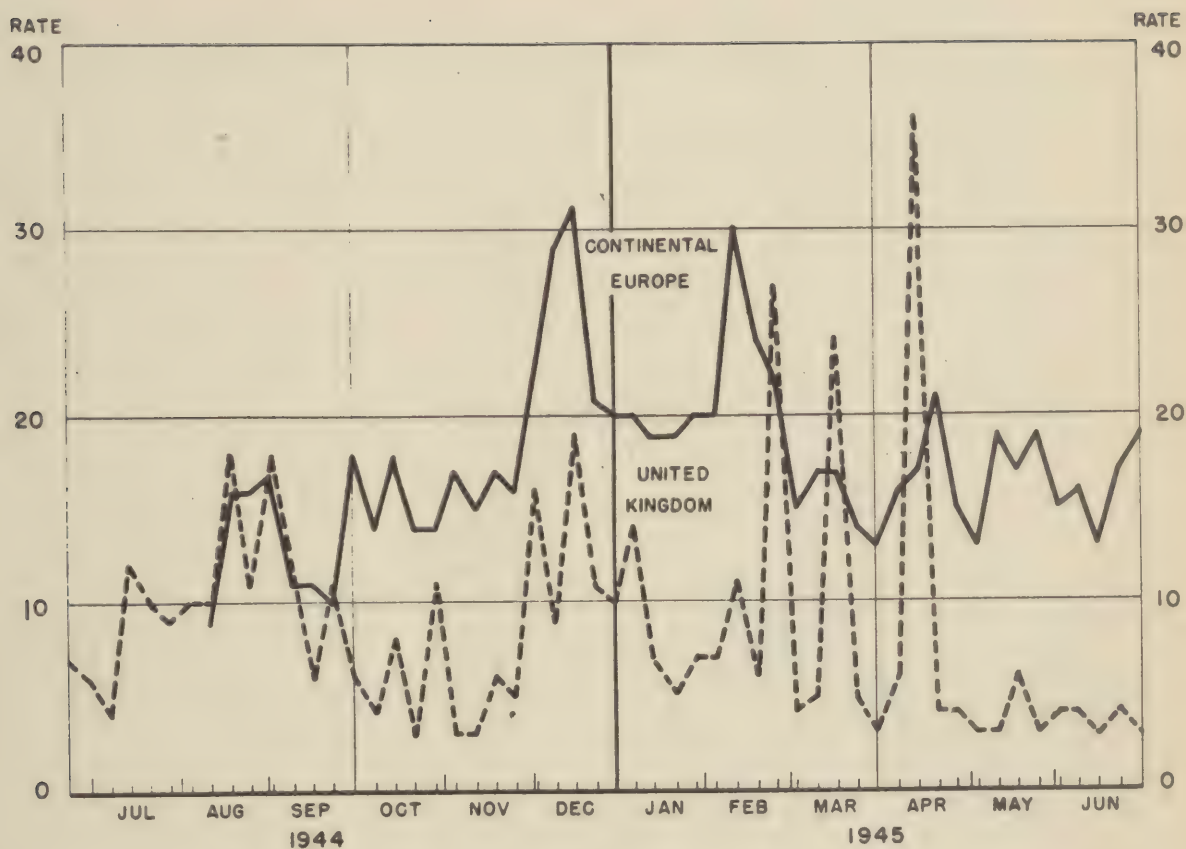


Figure 3

Intestinal Infections, Including Common Diarrheas and Dysenteries, United Kingdom and Continental Europe, Rates per 1000 strength per annum, by weeks, 23 June 1944 to 29 June 1945.



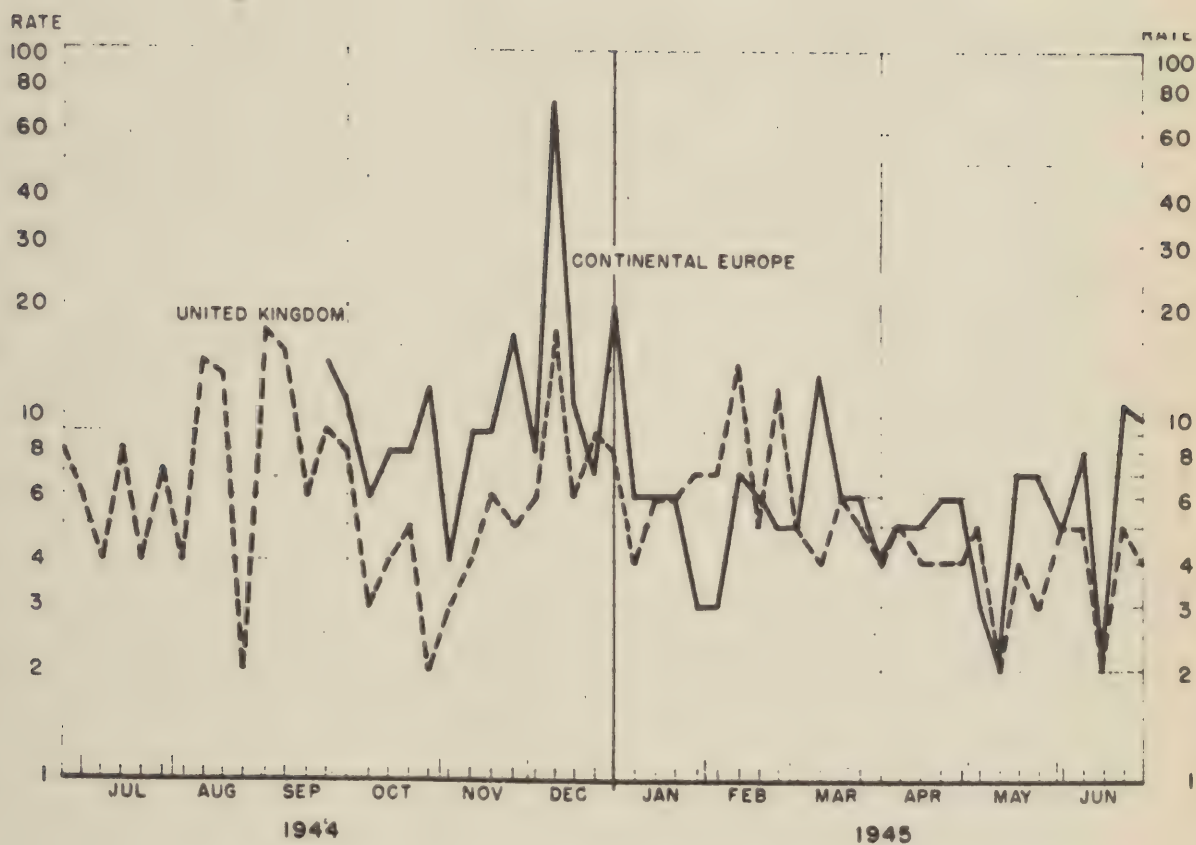


Figure 4

Intestinal Infections, Including Common Diarrheas and Dysenteries, Forces, European Continent and United Kingdom, Rates per 1000 strength per annum, by weeks, 23 June 1944 to 29 June 1945.





bulge in rates during the course of heavy operations in the autumn and winter, which then was followed by a uniform leveling off to a more or less fixed experience at a commendable level.

#### Racial Differences in Rates for Intestinal Infections.--

Throughout the course of this experience, the rates for the diarrheas and dysenteries among colored troops were consistently lower than those for white troops. (Figure 5, Table 11) The ratio held true both in the United Kingdom and on the continent where the general rates for the theater were somewhat greater. This was no novel experience. It had been noted for colored troops in Europe in the last war and is more or less consistently true in American military practice.

Mortality in the European Theater.--Only 5 deaths from all of the diseases included within the collective group of dysenteries and diarrheas were recorded during the four years that the European theater was operational. The mortality rate per thousand was 0.00126, an infinitesimal figure in itself, and particularly so in comparison with the rates that held in previous wars. All four of the reported deaths occurred in 1945 among troops stationed on the continent. One was due to amebic dysentery, one to bacillary dysentery and two were the result of common diarrhea.

The Wide-spread Epidemic of Diarrhea in Army Areas, Autumn of 1944.--Only once in the history of the theater was there a widespread and general outbreak of diarrheal disease, with large numbers of men involved and persisting for an appreciable period of time.

Common diarrhea in this military experience was a disease which in its typical epidemiologic manifestations struck irregularly, more frequently in summer than in winter, involved troops of a particular unit and was rather commonly related to some well-defined precipitating event. Epidemics in a particular location or region were ordinarily short-lived. Dysentery was clinically a more severe disease and tended to occur in outbreaks still more limited in size than those of common diarrhea. The epidemic which involved troops of the Army areas in the autumn of 1944 partook of the epidemiologic characteristics of both.

The epidemic first appeared among troops of the XIX Corps near Maastricht, Holland, about 1 October 1944. A similar condition existed concurrently in the civilian population of that region. From Holland, the disease spread gradually southward. Reports of its presence were received from several units of the XIII Corps about the middle of October. It invaded troops of the First United States Army, eventually made its appearance in the Third Army, and in December was widely prevalent in the Seventh Army. (Figure 6, Table 12)

From the time that the Seventh Army landed in southern France, it had had a consistently higher rate for the diarrheal diseases than other armies of the theater. These conditions were particularly prevalent during the march across France. A general improvement was noted in November. The recurring increased frequency in December was appreciated to be something new, of different clinical character from the ordinary diarrheas that had prevailed up to that time.

Outbreaks in a given troop area did not appear explosively as is characteristic of food-borne or water-borne intestinal disease. Spread was more nearly by extension and as a steady progression. The incidence within a given unit was not extremely high at any one time, although the greater part of an individual organization was affected before the epidemic ran its course. The ordinary epidemiologic behavior was for the peak of incidence to build up over a period of four to eight days, and then gradually taper off during the next few weeks. For example, the general dispensary in Luxembourg which cared for a number of units in that area, had 187 patients from 1 November 1944 to 17 December 1944 with 30 the greatest number treated on any one day. Officers and men were involved alike.

In its epidemiological and clinical manifestations, the outbreak resembled the situation which existed in France during World War I, where from July through September of 1918 a distinct excess incidence of diarrheal disease was reported among combat troops. In both instances the epidemic of diarrhea was an accompaniment of the height of a campaign, when general sanitary discipline would be expected to undergo severe strain.

The usual clinical reaction was decidedly mild. Only a small proportion of affected persons ever reported to sick call, and relatively few required admission to hospital. The onset was fairly sudden, with abdominal cramps and ordinarily four to eight watery stools within the next 24 hours. In most instances symptoms terminated within 24 to 48 hours, a longer course being exceptional. Nausea and vomiting were rare, although anorexia was more or less constant and often persisted for several days. Blood and mucus were uniformly absent from stools. Only a small fraction of patients had fever, and rarely did it exceed 100° F. The number of leukocytes was within normal limits. The above description was characteristic of the disease in areas where it appeared. In a number of places, however, coryza commonly preceded the diarrhea by about two days. This was true of the disease in the XIX Corps where the outbreak appears to have started, and seems to have been a general observation throughout the Ninth and Seventh Armies. However, the interval between coryza and onset of diarrheal symptoms was not constant. Coryza occasionally



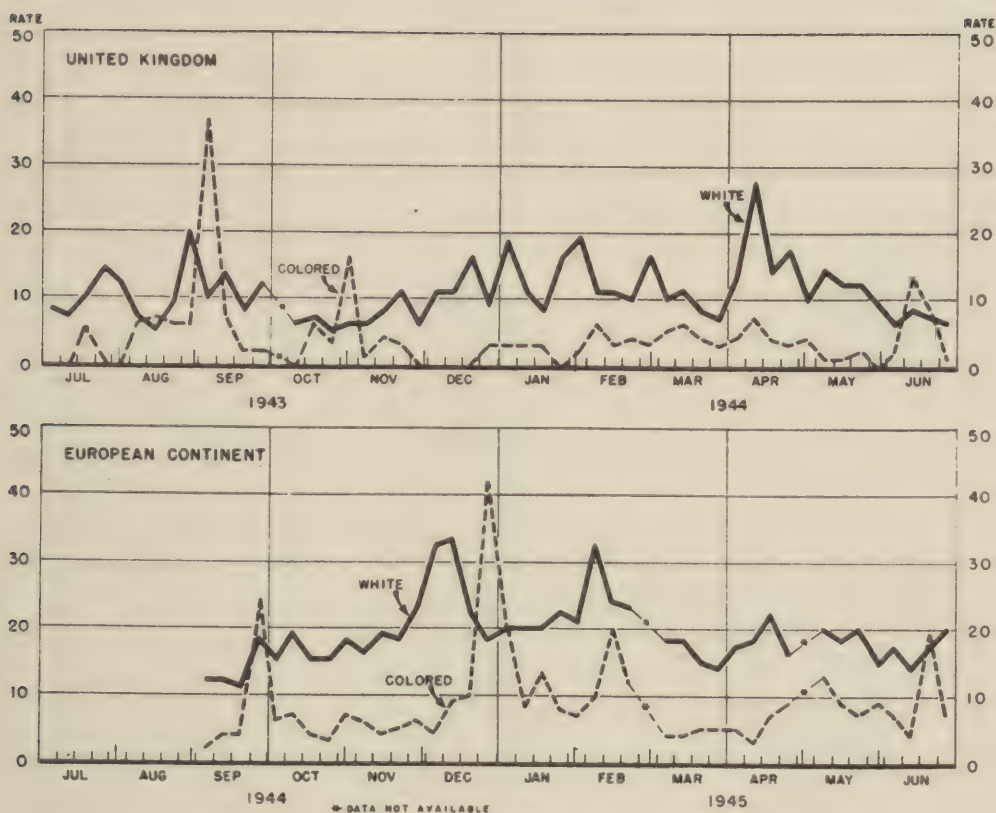


Figure 5

Intestinal Infections, Including Common Diarrheas, Colored and White Troops, United Kingdom and European Continent, Rates per 1000 strength per annum, by weeks, 9 July 1943 to 29 June 1945.



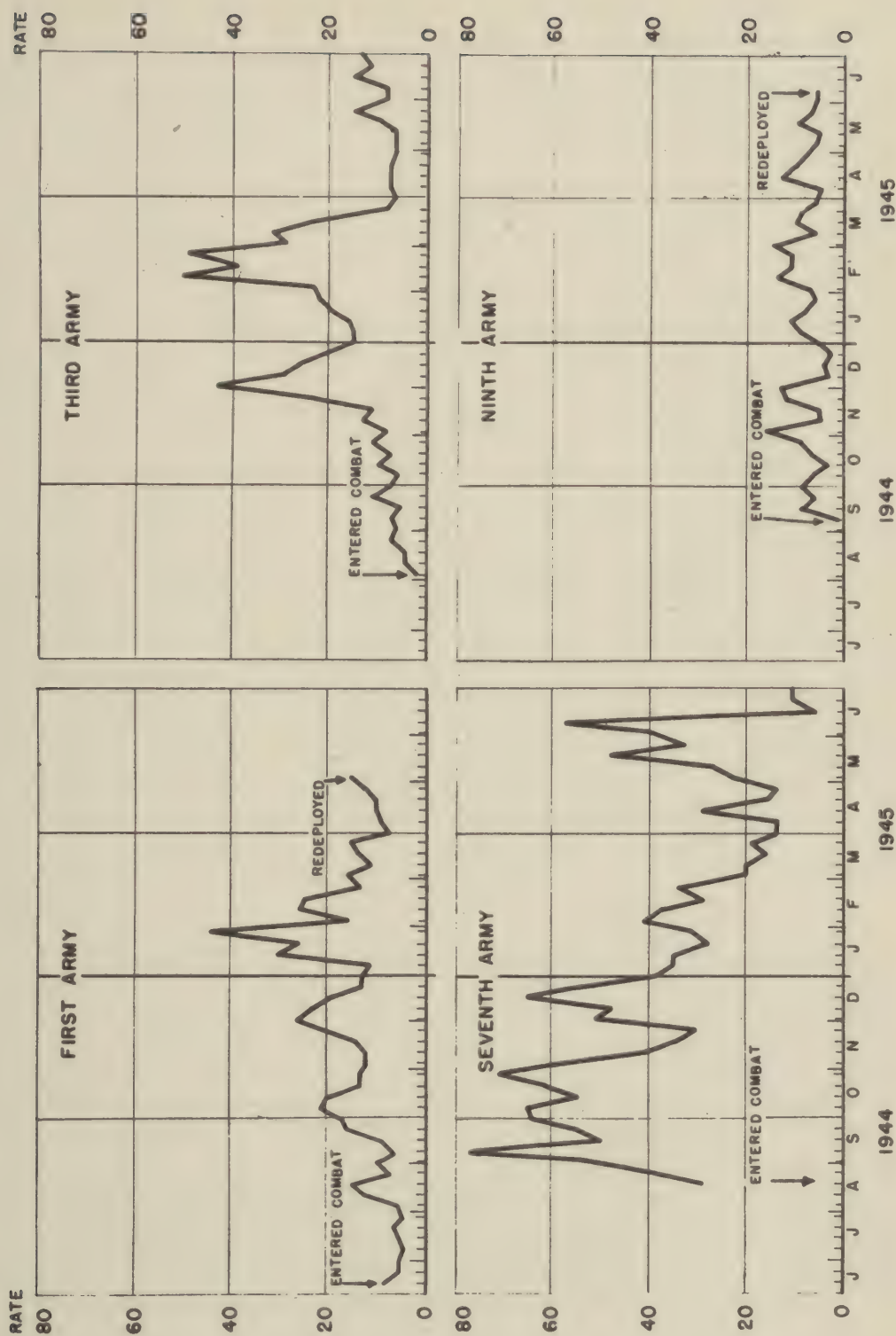


Figure 6

Intestinal Infections, Including Common Diarrheas, First, Third, Seventh and Ninth Armies, Rate per 1000 strength per annum by weeks, 9 June 1944 to 29 June 1945.





appeared with the diarrhea and sometimes shortly afterward. It was nevertheless the opinion of medical authorities of these two organizations that diarrhea rarely occurred without concomitant upper respiratory manifestations. This was not characteristic of the disease as it appeared in the Third Army, where medical officers were strongly of the opinion that upper respiratory infection was not a part of the disease syndrome.

Samples of feces and rectal swabs from patients in the acute stage of the illness were examined in the course of study in the XIX Corps in October. No pathogenic micro-organisms were isolated. No specific etiologic agent could be determined in the course of observations in Luxembourg. Bacteriologic studies in the Third Army, which were related to the more seriously ill patients of a circumscribed outbreak, yielded cultures of Flexner bacilli from samples of feces. This particular outbreak appeared definitely to have been bacillary dysentery. In other outbreaks in the Third Army, dysentery organisms were occasionally isolated but not with sufficient frequency to make certain that they were the cause of the outbreak. The increasing frequency with which dysentery bacilli were isolated from patients of the First Army as the epidemic progressed, gave evidence that this infectious agent was fairly widespread and was responsible for some of the mild infections that were then so common in that command. Of the strains isolated, eight were the Sonne variety, 14 were Flexner type, and one was type ambigua. The bacteriologic experience of the Seventh Army was similar to that of the Third, with isolation of dysentery bacilli in about fifteen per cent of stool examinations of patients. The type distribution was varied. (Table 13) The laboratory making these examinations had had wide experience with this infectious agent when more than fifty per cent of cases in a dysentery outbreak in North Africa had been confirmed bacteriologically. Bacteria of the Salmonella group were rarely encountered, so infrequently indeed as to discount any significance.

Water seemed to be a factor in only one local outbreak which occurred in the Third Army. No particular foods could be implicated. (Figure 7) The general epidemiologic behavior of the outbreak would indicate a relation to environmental sanitation. There is good reason to believe that this was probably a collection of epidemics rather than an entity. At least some of the illnesses were mild bacillary dysentery.

Outbreaks on Troop Transports.--The outbreaks of diarrheal disease that occurred on board ships bringing troops to the theater were among the most extensive in this experience. The conditions on troops transports favored such epidemics. Crowding was always great and reached extreme proportions during the autumn of 1943 and the early

part of 1944, when troop strength was being built up rapidly for the coming operations in France. Messing facilities were almost always inadequate for the number of men carried. (Figure 8) Field trained troops often found difficulty in accommodating themselves to the discipline and restriction of a ship. Transport commanders and transport surgeons were frequently inexperienced, and it was furthermore not at all uncommon for a medical officer to be assigned this responsibility with little or no previous notice and with meager instruction as to his duties. Latrine and ablution facilities often left much to be desired, and the men commonly slept in shifts. This not only increased the opportunities for contact infection, but required messes to function almost continuously without proper intervals for policing.

The inspection of ships practiced at ports of debarkation gave information on the nature and extent of the epidemics of diarrheal disease that occurred on ships and aided in determining the probable inciting factors. The control and improvement of conditions depended upon the cooperative effort of authorities in ports and staging areas of the Zone of the Interior, because that was where the necessary measures for limiting these situations had to be applied. Special reports from port authorities of the theater therefore supplemented the routine reports of transport surgeons.

The absence of laboratories aboard ships capable of dealing with epidemics of the size that occurred led to the result that the specific agent in these outbreaks was in no instance determined. At least one was suggestive of bacillary dysentery because of a recrudescence of diarrheal attacks shortly after the troops disembarked in Britain, with identification of the Sonne type of *Shigella paradysenteriae*. The clinical course, and the fact that only a single death occurred among thousands of cases suggested that most infections were of the type of common diarrhea.

Minor difficulties had been encountered from time to time in the course of troops movements by sea, but the first major epidemic of intestinal infection involved the USAT Argentina which arrived at Glasgow on 4 September 1943. In fact, this was the largest single outbreak of diarrheal disease in the history of the European theater.

The Argentina had sailed from New York shortly after the middle of August with 6,153 Negro troops aboard, together with the usual complement of officers and ship's company, and the naval gun crew. The ship was grossly overcrowded. Only three medical officers were included in the troop movement. Sleeping accommodation was such that soldiers slept in shifts, and since the shifts were rotated the three messes were further overloaded by reason of a succession of meals. The inherent potentialities for an outbreak of intestinal





Figure 7

An Army Mess under canvas, 95th Evacuation Hospital, Epinal, France,  
November 1944.

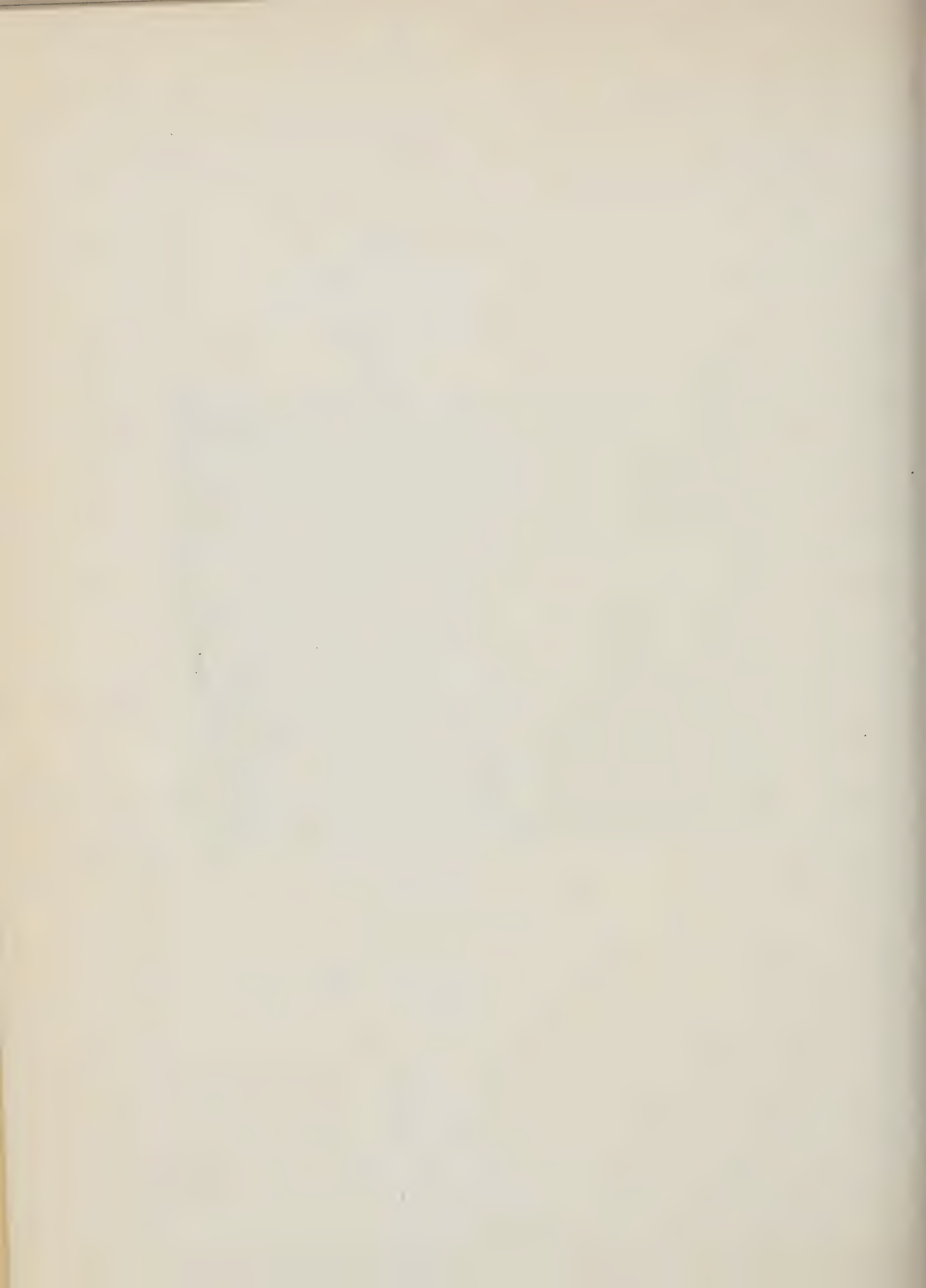




Figure 8


Messing on board a Troop Transport, November 1942.





disease were early recognized by the transport surgeon. In his first report to the transport commander he described the inadequacies in bathing and toilet facilities, the multiple sanitary deficiencies in galleys, pantries and the troop mess, and the lack of proper facilities for washing and sterilization of mess equipment.

During the night of 29 August 1943, some 400 patients were treated for acute diarrhea at the ship's hospital and dispensary. Three subsequent waves of infection occurred during the course of the next week and the number of patients approximated 3,000. The epidemic involved enlisted passengers, officer passengers and the permanent personnel of the ship. In addition to the estimated 3,000 patients who reported for treatment many more mild infections were known to have existed. The attack rate was estimated to have been well in excess of half the ship's population. One soldier died of acute intestinal infection. The specific infectious agent involved in the epidemic was never determined. Bacteriologic examination of stools from some of the more seriously ill patients who were removed to hospitals after the ship docked, failed to demonstrate any of the pathogenic bacteria commonly involved in such epidemics.



The port physician, reporting his observations made on boarding the ship shortly after her arrival, had this to say:

"The first impression was of gross overcrowding; the second, of filth and dirt everywhere. A long queue of soldiers waited outside the door of the dispensary, some so weak they had to sit or lie on the deck. The epidemic of dysentery had begun four days out of New York. All galleys, including that of the Navy gun crew and the civilian crew were in a deplorable state of sanitation. The main troop galley was the worst of the lot. The supposedly clean kitchen utensils had dirt, grease, and decaying food stuck to them. The stoves and tables were very dirty with old burnt grease and decayed food particles. The garbage disposal was extremely unsanitary. Garbage cans were coated with decaying organic matter and had not been washed for a long time. They were piled helter-skelter in a corner of the kitchen and their contents were spilled all over the deck. The troops were messing in the main mess hall. Half-eaten food was thrown over the tables and floor. In fact, the floor was so covered with waste food that one had to be careful not to slip and fall. The garbage cans just outside the main mess hall were the most nauseating scene I have seen on board a ship. Half a dozen soldiers were standing in garbage two to three inches deep around five or six garbage cans filled to overflowing with uneaten food. Sterilization and washing of trays was unsatisfactory. There was not enough soap in the water and the water was not hot enough to really clean the

trays in the very brief period that they were immersed. Inspection of the rest of the ship -- troop quarters, decks, and latrines -- revealed conditions just as unsanitary as in the kitchens. The troop quarters reeked with vomitus and diarrheal fecal matter from those who were ill and could not find a place in the latrines to relieve themselves. The latrines themselves were beyond description. I can truly say that I have never seen a United States Transport in such deplorable sanitary condition."

The Argentina epidemic was by no means an isolated experience during the month of September 1943. Records were at hand of sanitary conditions on all transports arriving in the United Kingdom from 1 January 1943 to 1 October 1943. Only one serious outbreak of diarrhea had occurred prior to that month. There were four in September. The USAT Shawnee arrived at Bristol 15 September 1943 with report of an outbreak of 362 cases of diarrhea. The epidemic had first become manifest on 9 September 1943. It lasted two days, and had completely subsided by the time the ship docked. This transport carried 1,843 military personnel. The history of the outbreak was particularly significant, and the control measures that were put into effect gave evidence of good epidemiologic sense. An investigation by the transport surgeon showed that the cooks, bakers and butchers of the permanent ship's personnel ate their food in the galley and had remained unaffected throughout the voyage. This led to the conclusion that the food was contaminated somewhere between the galley and the mess room. An inspection showed no evident contamination of food. It developed, however, that the kitchen police of the 2190-S Task Force had been relieved by men of the 2190-K Task Force on 9 September 1943. No diarrhea had been reported up to that time. The epidemic began on the 10th of September, the day after 2190-K took over. It was thereby deduced that a bacterial carrier probably existed among the personnel of that detachment of kitchen police. Clinical histories and physical examination directed suspicion to three members as having had diarrheal disturbances. The whole of the kitchen police of 2190-K were relieved of duty, the old detail of 2190-S was put back to work, and no further difficulties occurred during the remainder of the voyage.

A third major outbreak, on board the USAT Cristobal was considered to have been due to the fact that only 200 compartment steel trays were available to serve approximately 3,000 troops, while the rate of feeding was from 700 to 900 per hour. The opportunity for proper washing and sterilization of the trays was lacking, and the facilities that were provided were also unsatisfactory.

The fourth outbreak in September involved the transport Capetown Castle. An epidemic of 170 cases of diarrhea developed the third day out, with 20 cases reported the following day. The epidemic



was thought to be due to an inadequate system for washing mess gear. The outbreak was brought under control when chlorine was added to the final rinse water.

This grouping of epidemics within a period of a few weeks served to center attention on the need for added precautions, if freedom from epidemics of common diarrhea was to be insured on board transports. The military situation happily permitted a lesser degree of crowding. Measures were instituted at ports of embarkation to remedy the specific deficiencies brought out by these experiences, with the result that no serious difficulties were encountered throughout the rest of the year. The continued survey of health reports of transports showed only eight instances of excess incidence of diarrhea to have occurred in the course of 378 overseas troop movements to the theater from 1 January 1944 to 10 June 1944. Only three were of any moment and none was of outstanding seriousness until the eastward voyage of the HMT Nieuw Amsterdam in early June. The aid of authorities in the Zone of the Interior was again sought. The approaching summer season made repetition of such occurrences more likely, and the existing military situation required more than ever that troops arriving in the theater be in a good state of health and morale.

Only one serious epidemic of common diarrhea on board a transport was noted thereafter. The SS Mariposa brought 9,326 troops into Liverpool on 13 August 1944. Diarrhea had broken out among the men on the second day of the voyage. It reached a peak on the fourth day, when some 2,300 patients were treated at the dispensary. The total number of persons involved was in excess of 2,000, excluding those who failed to report at sick call. Clinically, the illness was not severe, although 200 or more patients were still under treatment several days after arrival at their station in Britain. The ship was greatly overcrowded and messing facilities were taxed beyond the limit of their capacity.

Diarrheal Disease Among Prisoners of War.--The really serious problem encountered by the United States Army in Europe in respect to the diarrheas and dysenteries had to do with prisoners of war. The conditions surrounding prisoners were not those of soldiers in the line. Demoralization was prevalent, and discipline had relaxed in marked degree. This was not characteristic of the enemy soldier alone, for it was noted also with our own soldiers recovered from German prisoner of war camps. It was a part of the prisoner of war complex. Add to that the extensive crowding that followed when prisoners of war were herded into cages, the deficiencies in sanitation, the inadequacies in messing, and the limited housing; and the groundwork was laid for diarrheal disease.

The rates for prisoners of war that existed during the early months of the campaign and through the winter were strikingly high

in comparison with the experience of soldiers of the American Army. They were essentially ten times as great. (Table 14) The situation did not, however, get out of hand and for prisoners of war was about what was to be expected. The policy of not retaining prisoners on the continent for any appreciable length of time during the early months of operations was an important factor in determining this relatively favorable situation. The reasons were operational. The matter of security was a consideration, since it was not good to have large numbers of prisoners in our immediate rear. It was wasteful of combat troops to use appreciable numbers in guard duty. Consequently prisoners of war were rather promptly evacuated to the United Kingdom or to the Zone of the Interior. Diarrheal disease in the European theater was essentially a problem of prisoner of war enclosures on the continent. It did not enter into serious consideration in the camps of the United Kingdom, nor of the Zone of the Interior.

The changing form of operations was constantly reflected in the varying rates for diarrhea and dysentery among prisoners of war. When operations were active, when the numbers of prisoners taken were great, when the care that could be devoted became less, when overcrowding was increased, then the rates for diarrheal disease were up. Table 14 illustrates these fluctuations. Beginning in early autumn, considerable numbers of prisoners were held for labor and other duties on the continent. The rates for diarrhea were relatively great for September and October. They improved somewhat and then reached a high point in December, in connection with the Battle of the Bulge. Thereafter, a steady improvement took place until a very respectable rate of 75 was reached in April. The deluge came with the end of the war in the first week of May.

The breakup of Germany and its armies is an old story now; how everything seemed to tumble like a house of cards once it started. The debacle overwhelmed many services of the Army in the early days of May, other than those having to do with the care of prisoners of war. German soldiers surrendered by armies; hundreds of thousands within days. (Figure 9) The facilities provided for receiving prisoners of war were wholly insufficient. One camp, built originally to house 30,000 men, had to take care of 170,000. The enclosures for prisoners of war met their name. They were cages and little more. So great were the numbers that scarcely more than a pretext of proper care could be provided. Water supplies were alright as far as they went, but the amount of water available per man was hopelessly small. Messing equipment did not begin to go around and thousands ate out of tin cans discarded from the ration. Facilities for sterilizing kitchen equipment and mess gear were greatly overtaxed. Some cages were so crowded that the men scarcely had room to lie down and they slept in pup tents, improvised shelters, fox holes or in the open. The approaching warm weather led to an increase of flies, but never to the extent that would have existed without the aid of DDT spray.

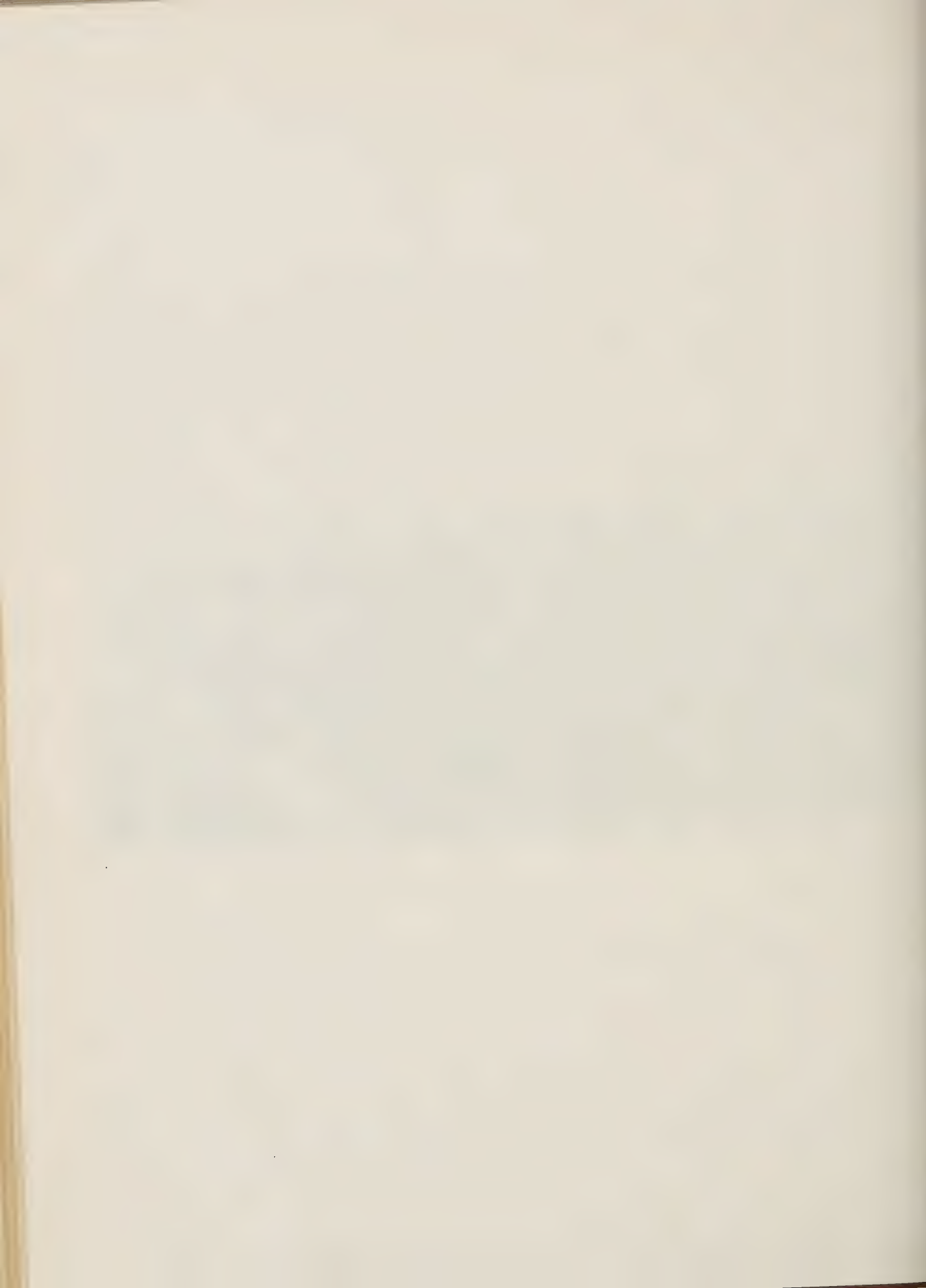




Figure 9

✓ Prisoner of War cage in Rheinburg, Germany, March 1945





The situation was further aggravated in areas where some of the most crowded cages were located by a series of unprecedented rains which turned the enclosures into a morass and the prisoners into shivering wretches. Dysentery was inevitable.

The first days of May showed huge numbers of cases. It was wholly a camp disease, for the conditions surrounding a whipped army had come into play and large numbers of prisoners arrived at the enclosures already suffering with intestinal disease. The conditions there favored its ready spread. In some of the larger camps more than a hundred cases were frequently reported in a single day. As many as two or three thousand would be suffering from dysentery at a given time.

The problem that faced officers of the line and medical officers at prisoner of war enclosures was so great as to appear almost unsolvable. Typhus was prevalent throughout the region, and the work of delousing was alone a stupendous task. Messing arrangements had to be improvised from little or nothing. Hospitals were moved in to take care of the seriously ill patients, water supplies were enhanced, and latrine and ablution facilities enlarged. Order was brought out of what was little better than milling chaos. Those days appear rather abstract, as these brief details are set down well in the backwash of a war that is over. They had to be lived, in order to appreciate what the Armies in the field faced at that time with an avalanche of prisoners of war that seemed to pour in endlessly. What was accomplished in the week that followed the end of hostilities was no less than remarkable. By the middle of May the situation was under control in most enclosures, and the end of the month saw a most decided improvement. But the rate for the diarrheas and dysenteries that month of May touched 735 per thousand strength per year, and the bulk of it occurred in the first two weeks. The rate for June was half the May figure, and conditions settled down thereafter to about the level that had characterized previous experience. The toll in lives was relatively great. Complete data in respect to deaths are not yet available, but for the prisoner of war camps under the jurisdiction of Advance Section, Communications Zone, information is available for 403,142 prisoners. There are 833 deaths from diarrhea and dysentery during the six weeks period from 1 May 1945 to 15 June 1945.

The greater part of this outbreak was certainly bacillary dysentery. Various strains of Flexner type organisms were isolated from patients, although the examinations represented but a sample of the unusually large number of cases that occurred. The clinical nature of the disease as observed would also indicate that the great proportion of cases were bacillary dysentery; and this is corroborated by the appreciable case fatality. To one who has seen a good many kinds of epidemics in a good many kinds of places, few situations will measure up to an outbreak of bacillary dysentery. Typhus sometimes will, but it tends to occur in the colder months and the smells



is not so bad. The squalor and misery of a dysentery epidemic are rarely equaled.

Experiences such as those just described for prisoners of war and the huge outbreaks that occurred on board transports are perhaps good for the soul, although scarcely comforting to the spirit. It is easy to become complacent about the diarrheas and the dysenteries when annual rates of 16 characterize the experience of an army in the field in a decidedly active campaign. It is easy to lose respect for a group of diseases when it is necessary to search through four years of experience to find four deaths. These examples of what can happen when modern sanitary practice is relaxed, serve to justify the stress placed on environmental hygiene in military practice, even to the extent of its becoming almost religion. It pays dividends.

The Common Diarrheas in ETO.--The very mixed group of infections included within the collective term of the common diarrheas have the common characteristics of sudden onset, brief duration, well evidenced symptoms of diarrhea, a varying degree of abdominal pain and tenesmus, rapid recovery and essentially no death rate. Such exception in respect to deaths as are recorded likely represent failure to recognize some more serious intestinal infection, for example, bacillary dysentery. Epidemiologically, they are characterized by groupings of cases related to a particular event and ordinarily coincide with a high attack rate in a given population group.

The specific infectious agents, for assuredly this is a mixture of diseases, remain unknown. The former tendency to place considerable stress on dietary indiscretions as a causative factor seems less and less warranted. These conditions give every evidence of being infectious diseases. There is close correlation of their epidemiologic behavior with that of known specific intestinal infections. The same rigidly applied sanitary discipline acts in reducing the incidence of all intestinal disease, known specific infections and these others as well. (Figure 10)

Classification.--A change in the army system of classification instituted in January of 1944, served to separate food poisoning as a reportable condition distinct from the common diarrheas. Food poisoning in previous years had been included presumably within the group of common diarrheas. It is certain that a great proportion of food poisoning after 1944 was still so recorded. For purposes of determining a continued trend, the two categories had best be combined.

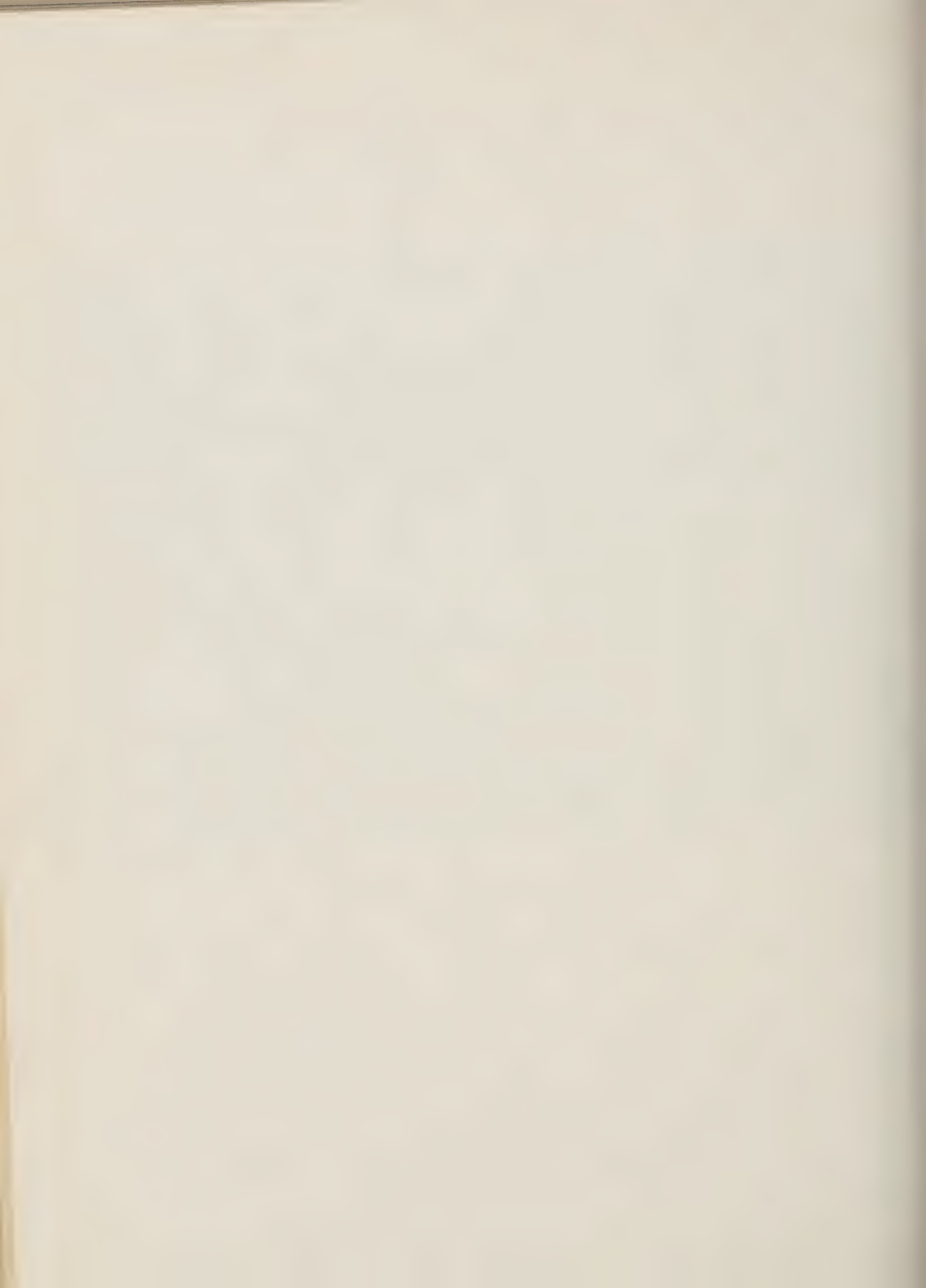
Modes of Transmission.--The means of transmission involved in a given outbreak of common diarrhea often remained wholly undetermined. Foods were commonly concerned, with contamination taking place either in the course of preparation or during storage of the prepared food. The role of carriers among food handlers received full consideration. Reports from the field stressed repeatedly the relationship of these intestinal infections to upper respiratory disease. There is every reason to believe that foods can be contaminated with the





Figure 10

Early Sanitary Construction in Normandy, July 1944.



discharge from the upper respiratory tract and give rise to food poisoning. There is no precise evidence to support the existence of an epidemic diarrheal disease of the nature of intestinal influenza, of presumed virus etiology and clinically presenting associated symptoms of the upper respiratory and intestinal tracts. Many outbreaks were attributed to contaminated water. Some few could be established as water-borne. Flies undoubtedly had a part in transmission, although in this experience a relatively small part.

Incidence.--The common diarrheas constitute far and away the great bulk of the intestinal infections. The distributions by year and by month for the European theater are presented in Table 15. Comparison of these data with those of Table 6 shows the annual rates to coincide closely with the annual rates for the general group of diarrheas and dysenteries, since the common diarrheas are the dominant factor in that aggregation. The anticipated seasonal variations were not always evident. The influence of active military operations can be repeatedly demonstrated to bring about an increased frequency of these conditions, of such force as to override in importance the expected normal seasonal fluctuation. Operation TORCH was mounted in September, 1942. The rates for the common diarrheas in the succeeding three autumn months, until the task force finally left England in November, were much greater than in mid-summer. The great concentration of troops in southern England in preparation for the invasion of Normandy led to a nonseasonal increase in rates in the spring of 1944, despite the intense effort placed on mess sanitation in the staging areas. The low rates at the beginning of continental operations did not correspond with predictions. It would appear that attention to such minor distractions as the common diarrheas gave way to more serious interests and that reporting was below par. Furthermore, the time that was required to establish satisfactory facilities for recording disease incidence on the continent, made all records other than those of battle casualties indefinite and unsatisfactory at that time. The November offensive of 1944 and particularly the Battle of the Bulge was associated with materially increased rates. This situation held through January and February 1945, with mid-winter showing some of the highest rates in the history of the theater. The slackening of the bitter winter warfare brought improved performance despite warmer weather and conditions ordinarily favoring increased rather than decreased rates.

Sources of Infection.--A sudden outbreak of diarrheal disease involving a considerable proportion of a command almost invariably leads the inexperienced observer to suspect the water supply. The cause is far more likely to reside in food. This may come about through spoilage of the ingredients of food, through contamination in the course of preparation, or through inadequacies in serving or of the utensils in which food is served.



A fairly satisfactory idea of the sources of infection for the common diarrheas is derived from an analysis of 70 epidemics reported in the European theater during operations in England. These outbreaks occurred within the period January to October, 1943, inclusive. The interpretations as to source of infection and probable cause were derived in most part from the reports of unit surgeons, although not infrequently they came from epidemiologic studies by preventive medicine officers of one or other of the major commands. Some reports were forwarded by unit surgeons, because of a special interest in the problem. Many came to hand through the monthly sanitary reports. Special investigations were sometimes made as a result of inquiry by the Chief Surgeon, because of unusual numbers of reported cases of some peculiarity in the attendant circumstances. The epidemics included in the series are believed representative of military experience in the European theater. All the outstanding epidemics within the stated time are included, and the series represents approximately two thirds of the recorded outbreaks. Five epidemics occurred among troops on board transports coming to the United Kingdom, two were in American Red Cross clubs, and the remainder involved troop units. Of the total 70 epidemics, 32 were ascribed to contaminated foods, 7 to unsatisfactory water supplies, and 13 to various unsanitary conditions in messes, including inadequate facilities for washing mess gear. The causative factor in 18 outbreaks was frankly stated to be unknown.

A second similar review of experience for troops serving on the continent during the active campaign, recorded experience for the period 1 September 1944 to 31 December 1944. The distribution of sources of infection, based on epidemiologic study of 84 outbreaks, attributed 35 to food, 6 to contaminated water, and 15 to unsatisfactory mess conditions. The number remaining wholly indeterminate as to cause was 28.

Water-Borne Common Diarrhea.--As a general rule, the outbreaks that were attributed to polluted water involved a large proportion of the affected military population, were almost invariably of sudden onset, and ended promptly. Some unusual circumstance associated with the water supply was a regular incident in the history. The reports of the epidemics that follow are illustrative of this relatively rare type of outbreak of common diarrhea.

EPIDEMIOLOGIC CASE REPORT NO. 1 - A battalion of the 347th Engineer General Service Regiment was engaged in the construction of a large camp in Great Britain. Water was derived at first from the nearby community supply. The permanent supply for the camp was to be from a river for which a filtration and chlorination plant was under construction. Due to a misunderstanding, the water for the new source was turned on before the purification plant was properly working. This resulted in raw water flowing through the

pipes of the distribution system. As luck would have it, lemonade was served that day in the mess halls and was made with this water. Water from this source was turned on for only a few hours during the morning of 26 September 1943, but samples of the water from the distribution system taken the following morning were shown by subsequent laboratory examination to be heavily contaminated with colon bacilli. Prompt use of chlorination through Lyster bags served to limit the outbreak. Bacteriologic examination of feces from patients with diarrhea failed to identify a specific microorganism.

The outbreak was limited essentially to troops in the 2nd Battalion of the regiment, with a strength approximating 900 men. On 27 September 1943, 31 persons reported to sick call with complaints of malaise, nausea, intestinal cramps, vomiting or frequent stools. All patients were afebrile. The following day 102 men of the battalion reported sick; and on 29 September 1943, the number was 29 (Figure 11). These numbers by no means represented the total attack rate, for the unit surgeon reported that essentially one-half of the men of his command suffered similar complaints, although not of sufficient seriousness to warrant report at sick call. The course of the disease was short, with recovery of most patients within 24 to 36 hours. It is of note that a similar outbreak occurred among men of a single company of British engineers working in the same area. The first illnesses were likewise noted on 26 September 1943.

EPIDEMIOLOGIC CASE REPORT NO. 2 - A particular communal Site B of the 127th AAF Station suffered serious contamination when flow of sewage was obstructed through failure of a sewage pump. The epidemic of diarrhea that followed was limited to troops of that site. The drinking water was found to be non-potable by laboratory examination. That from other sites of the post was of good quality. A meticulous investigation of the food served at messes eliminated that possible source of infection. The epidemic ceased promptly with institution of emergency treatment measures.

EPIDEMIOLOGIC CASE REPORT NO. 3 - More than a fourth of the command of the 2nd Chemical Mortar Battalion were affected by a sharp outbreak of intestinal infection when they moved into an area in France and drew their water from a French water point. The water was proved non-potable, and evidence of previous chlorination was lacking. The epidemic ceased with institution of proper chlorination.

Because of the epidemiological considerations governing outbreaks of common diarrhea due to water, they most often involve Engineer construction units, combat troops in the field, and other similar units making use of emergency and untested water supplies. They occurred more frequently on the continent than in Great Britain.



✓ Food Borne Common Diarrhea.--The distinction between food-borne common diarrhea and food poisoning is more or less artificial. Classification in one category or the other depended as a rule on the inclination of the unit surgeon reporting the circumstance. If a pathogenic bacterium commonly associated with food poisoning was identified by examination of the food or of the discharges of patients, it was common practice to report the outbreak as one of food poisoning. If no pathogenic micro-organism was isolated, the epidemic was more likely to be recorded as one of common diarrhea. Traditional practice also had a decided influence in determining the decision. Common diarrhea is an old accepted term. The newer terminology of food poisoning was less familiar and implied to some medical officers more careful study and detection of causes than had perhaps been accomplished. Nevertheless, the same epidemiologic influences operate. Although transmission of infection by food was responsible for more outbreaks of common diarrhea than probably all other agencies combined, discussion of the several mechanisms and of the contributing conditions will be reserved for the subsequent section concerned with food poisoning.

The Dysenteries.--The Greeks gave the name to the diarrheas and the dysenteries but an old sergeant in the Pacific Theater had his own way of differentiating these two conditions. In his briefing of recruits making their first trip to tropical regions, he explained it: "If you've got the GI's, that's diarrhea; and if the GI's have got you, that's dysentery". The dysenteries are the more serious condition. The death rate is greater and the period of disability longer. Of the total 44,479 cases of diarrhea and dysentery reported in the European Theater during four years, (Table 6) 3,529 were dysentery or 7.9%. Two principle forms of dysentery were distinguished, the one protozoal, the other bacterial in origin. For purposes of classification they were recorded as amebic dysentery and bacillary dysentery.

Army Regulations required that the specific infectious agent be isolated and identified if a patient with symptoms suggestive of intestinal infection was to be classed as suffering from either bacillary or amebic dysentery. If clinical criteria were alone the basis of diagnosis, the condition was called dysentery, unclassified. The result was that the greater proportion of dysenteries fell unto the unclassified group. The bacillary dysenteries were the next largest and the amebic dysenteries were third. (Table 16)

Most bacillary dysentery occurred under conditions of active campaigning, which has been characteristic of dysentery in armies in many wars. The conditions for satisfactory identification by laboratory examination were scarcely favorable. Stool specimens were delayed on the way to the laboratory and most of the patients had been ill for several days before reaching a hospital at which bacteriologic



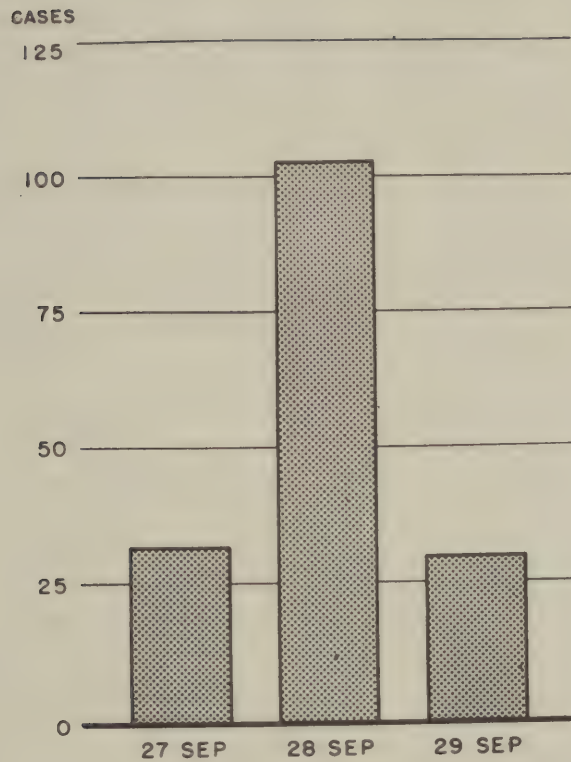


Figure 11

Epidemic of Water-Borne Common Diarrhea, 347th Engineer Regiment, United Kingdom, September 1943.



work could be initiated. The result was that the disease was called dysentery unclassified or put in the category of the common diarrheas, largely dependent upon the severity of the clinical state.

The infectious agent of amebic dysentery is fairly easy to recognize. The patient need not be in the same early stage of the disease, nor the stool recently passed. As a technical procedure, the demonstration of *E. histolytica* is simpler than the identification of the dysentery bacillus, particularly if type determination is included.

Carriers of the amebae producing dysentery were found to be numerous in the American military population. Undoubtedly a number of insecure diagnoses of amebic dysentery came from demonstration of amebic cysts in stools of patients with enteric symptoms but actually suffering from bacillary dysentery. These several considerations led to the belief that the number of cases of bacillary dysentery presented in Table 16 was materially understated, that the number of amebic dysentery was not far from fact and if anything overstated, and that most of the patients listed as having suffered from dysentery unclassified, in reality were representative of the bacillary form of the disease.

The dysenteries are proverbially diseases of greatest incidence in the summer months and yet that conclusion is difficult to substantiate by inspection of Table 17. The few scattered cases in Great Britain in 1942 fall into that pattern, but those of 1943 do not. The principal frequency was during the winter months of January, February, and December. Relatively little dysentery occurred that summer. Because a great part of the American troops were in France during the latter half of 1944, all normal bases of comparison were disturbed. Dysentery under ordinary circumstances is more prevalent on the continent than in the United Kingdom. It was regularly so in the experience of the United States Army during this war. The rates for the dysenteries increased appreciably during the summer of 1944, but the last quarter of the year had far and away the greatest number of cases. This was attributed more to an increased opportunity for exposure than to seasonal influence.

Amebic Dysentery.—The frequency of amebic dysentery during the first two years of the European Theater cannot be determined, since differentiation of types was not made available in statistical reports. The dysenteries as a group were never prevalent in Great Britain (Table 17) and that held especially true for amebic dysentery (Table 18). Civilian health information likewise indicated no common prevalence of the condition. The distribution of cases by months for 1944 and 1945 shows as a significant feature a loading toward the end of 1944, with one-half of the cases for the year concentrated in the final three months. Rates increased decidedly after the invasion of



France, an experience which continued through 1945 when rates were measurably higher than in the preceding year. The maximum rate for any one month was 0.4 per thousand per annum.

The clinical manifestations of amebic dysentery, as observed in this experience, presented no unusual features. The greater proportion of patients had been previously stationed in the Mediterranean Theater. The clinical history in many instances showed that the disease recognized during service in Europe was actually a relapse of a previous infection.

Several small outbreaks occurred among personnel of hospital units previously stationed in Africa. The origin of the first infection was not always apparent. In addition, a goodly number of chronic amebic dysentery infections were recognized among soldiers who had previously not been resident outside continental United States. The following is illustrative:

EPIDEMIOLOGIC CASE REPORT NO. 4 - An officer of the 79th General Hospital, stationed in North Ireland experienced indefinite symptoms of tiredness and listlessness for several months, unaccompanied by loss of weight. Mild episodes of diarrhea had been noted in November 1943, and in April, 1944. The past history included an attack of dysentery in New Orleans in the spring of 1938, said to have been amebic; and another one year later, thought then to have been bacillary. Specimens of feces taken at the time of a proctoscopic examination, 2 June 1944, revealed numerous cysts and trophozoites of *E. histolytica*.

Histories of the sporadic amebic infections reported during the time troops were stationed in Great Britain were so commonly indicative of relapsing chronic infection that it was believed relatively little endemic infection existed in the population of the British Isles. Studies failed to reveal a single instance of infection resulting from eating fresh fruits and vegetables. This evidence was corroborated through information furnished by British health authorities and through examination of feces from civilians. The incidence of amebic cysts was decidedly low. However, several general surveys of American military populations showed a high level of infestation, in one instance 19% in a division coming directly from the United States.

Similar examinations made by the 1st Medical Laboratory attached to the Seventh Army on the continent, showed a relatively high incidence among men of that command who had served with the organization in the Mediterranean Theater. The frequency of amebic infestation among French civilians was said to be low.

Greater numbers of cases of amebic dysentery were reported on the continent, compared with the previous experience in Britain. The proportion that were newly acquired, and the number representative of relapse, is unknown. Distinction was not made in medical reports. It is known that the three divisions of infantry that came from the Mediterranean Theater had relatively high carrier rates for *E. histolytica*. This is presumptive evidence that many of the reported instances were actually chronic infections. It is reasonable to believe, however, that a far greater number of newly acquired infections were encountered in France than in Great Britain.

The typical epidemiologic behavior of amebic dysentery is one of long continued appearance of sporadic cases. Groupings of cases in outspoken epidemics are rare although reported, the Chicago outbreak during the Worlds Fair being the classical example. Only once in the history of the theater did consideration of an extended and widespread outbreak of amebic dysentery come into consideration.

EPIDEMIOLOGIC CASE REPORT NO. 5 - The Fifth Infantry Division had served in Iceland from April 1942 until August 1943, when it was transferred to England, and subsequently, October 1943, to North Ireland. No outstanding outbreak of diarrhea had occurred in the history of the division until the disease appeared in December 1943 among men of the artillery camp at Mourne Park, North Ireland. The camp included the 19th Field Artillery Battalion, the 46th Field Artillery Battalion and the 50th Field Artillery Battalion with a total strength of about 2,200 men. Each battalion had a mess for enlisted men, while a single consolidated mess served all officers. The distribution of diarrhea was universal. A small outbreak of 21 cases involved the 46th Field Artillery Battalion the week ending 10 December 1943. The following week there were 4 cases, the next week 15. The 50th Field Artillery Battalion had 11 cases the week ending 31 December 1943. Subsequent numbers are reflected in Table 19. The difficulties that continued through January and into April were also universal in distribution. During the first two months a series of small outbreaks involved one or other of the battalions and sometimes all three. In mid-March the number of reported cases increased decisively, with all three battalions involved. The cases of Table 19 represent patients reporting for treatment. Attending surgeons estimated that in some instances as many as half the command were affected. Two officers became ill with diarrheal disturbance about 5 March 1944. Examination of their stools showed cysts and motile forms of *Entamoeba histolytica*.

Both officers had eaten away from the organization mess on a number of occasions. Twelve enlisted men with diarrheas at this same time, gave no evidence of amebae nor did stool cultures reveal significant bacterial agents. The recognition



of the two cases of amebic dysentery among officers of the unit led to a survey in late March of 1944 of all food handlers in the various messes. Single stool examinations of 162 men showed 18.5% positive for *E. histolytica* cysts. One specimen contained a *Salmonella*, Group C. Shortly thereafter, a second series of examinations by another laboratory, selecting men of the unit without relation to occupation and at random, served to demonstrate a frequency of cysts in the same proportion, 19 percent.

The water supply at the camp had been demonstrated to be non-potable at the time these units arrived. Throughout the period at the camp all three units had been ordered to use water from Lyster bags. The character of the outbreak of diarrhea had repeatedly directed attention to the water supply. Frequent examinations showed the water from the Lyster bags to be potable, while that from the camp source continued to be non-potable. The messes of the camp had certain deficiencies that might conceivably have been responsible for some of the minor outbreaks, but scarcely for the continued prevalence of diarrhea in the amount that existed. The civilian health authorities of the region reported the neighboring population as having much the same experience with diarrhea. Other nearby camps with different water supplies were having no trouble.

A central chlorinating plant was eventually put into operation on 3 April 1944. The number of reported cases decreased to such an extent that for the first 14 days of April only 26 were reported for all three organizations, essentially the level of endemic prevalence of common diarrheas to be anticipated in similar regions. All carriers of entamebic cysts among food handlers had been relieved from that duty.

The frequency (18.5%) of *E. histolytica* cyst carriers in this unit as shown by survey was greater than for American civilian populations generally. However, a survey of troops from a division in England showed a comparable rate of 16.1 percent. The two cases of confirmed amebic dysentery were not related apparently to the outbreaks of common diarrhea in the camp. Water would appear to have been the most probable cause through non-observance of the prescribed water discipline in the face of a known non-potable supply. Diarrhea decreased markedly following installation of a central chlorinating plant, and a technic of purification which would not have freed water from viable amebic cysts. The frequency of fallacious interpretation of individual cases of diarrhea due to other cause, by reason of finding cysts of *E. histolytica* in the stools, was a matter of repeated experience in the course of medical operations in this theater. This is an instance of similar erroneous reasoning in respect to an epidemic.

Bacillary Dysentery.--The bacillary dysenteries were the largest element in the general group of dysenteric infections. Of the total 3,529 cases of dysentery of all forms 1,054 were determined to be bacillary



dysentery, in the proportion of 30 percent. In all probability most of the infections listed as dysentery, unclassified, were also of the bacillary type, which together would represent 70 percent of the whole.

The distribution of bacillary dysentery by months (Table 20) shows the same irregularity that characterized amebic dysentery. More than 45% of all cases of bacillary dysentery of 1944 were concentrated in the last quarter of the year. The rates that were established then were maintained in 1945, and not until May was there a measurable improvement. The influence of an active campaign is well brought out. Whenever troops move, whenever established sanitary disciplines are interrupted, the likelihood of a developing outbreak of dysentery is increased. The repeated and extensive outbreaks of diarrheal disease on transports bringing troops to Britain have been described. At least one was in all probability due to the dysentery bacillus; others may well have been. The following circumstance is in point:

EPIDEMIOLOGIC CASE REPORT NO. 6 - A shipment of a thousand men arrived at a staging area in England 12 January 1943, directly from the transport which brought them to Europe. No previous outbreak of diarrhea had occurred at the camp to which they reported, nor had dysentery ever been recognized there. After their arrival, the troops were restricted to the camp area. On 24 January 1943, nine days after disembarking, the infectious agent involved in a case of acute intestinal infection was confirmed bacteriologically as *Shigella paradysentery*, variety *sonnei*. In the course of the next three weeks 54 clinically similar cases were recognized, of which 19 were confirmed bacteriologically as due to the Sonne dysentery bacillus. Epidemiologic inquiry gave information that one man had had an acute diarrhea aboard ship, so mild that he had not reported sick and had recovered within three days. The camp epidemic was believed to have started on board ship. Outbreaks were common under such circumstances. The same sanitary deficiencies so many times characteristic of transports were known to have existed in this instance. Dysentery had not been present among these men in the camps where they were stationed in the United States.

An examination of 36 food handlers made shortly after the epidemic began, demonstrated one to be a carrier of dysentery bacilli of the Sonne type. He was considered the immediate source of the epidemic in the staging area. The outbreak throughout its course was limited to the group in which it started.

Many similar instances associated with troop movements were recorded in the history of dysenteric disease during operations on the continent. A unit would move in a shuttle operation across country,

and find accommodations in an abandoned building, or bivouac in some isolated field. Sanitary facilities were lacking, the hour was late, provisions for sleeping and cooking were often extemporized, and it was little wonder that the inevitable breaches in good sanitary practice were followed by outbreaks of dysentery.

No extensive outbreak of bacillary dysentery is included in the list of confirmed epidemics of this disease which came to the attention of the theater epidemiologic service. The largest involved 183 patients at Camp Northway in the Ashchurch Garrison Area in England. The causative agent was a dysentery bacillus of the Flexner type.

Most recorded outbreaks were of decidedly lesser extent, usually with less than 50 persons involved. Many confirmed cases represented sporadic infections or small groupings of three or four cases, rather than outspoken epidemics. Compared with the common diarrheas, more of the frank epidemics could be traced to food handlers, perhaps because of the greater definiteness of the infectious agent and the better available bacteriologic methods. (Figure 12) One outbreak of food handler origin established a permanent place in the dysenteric annals of the theater, not so much because of any unique epidemiologic feature but because of the site this particular Sonne strain chose to invade.

**EPIDEMIOLOGIC CASE REPORT NO. 7** - The headquarters mess of the Services of Supply at Cheltenham, England, housed about 40 ranking officers of the theater. The attendants were mainly British civilians. An outbreak of diarrheal disease among the domestic staff began about 1 February 1943 and ultimately involved 15 persons, three of whom were resident officers. Bacteriologic examination of the stools of 11 food handlers revealed 2 carriers of *Shigella paradysentery sonne*. Removal of the carriers served to terminate the outbreak.

A goodly proportion of outbreaks were transmitted through the agency of food, in much the same proportion as were epidemics of the common diarrheas. An example of such a localized experience is that of 23 officers and nurses of the First Medical General Laboratory who developed dysentery due to bacilli of type Boyd 103, as the result of contaminated tomato juice served at breakfast 10 March 1945.

Only one epidemic was traced to water with certainty and curiously enough a Sonne type of shigella was stated to have been isolated from the water, an uncommon accomplishment.

Several of the recognized types of *Shigella* were isolated in the course of investigations of various outbreaks of dysentery. The



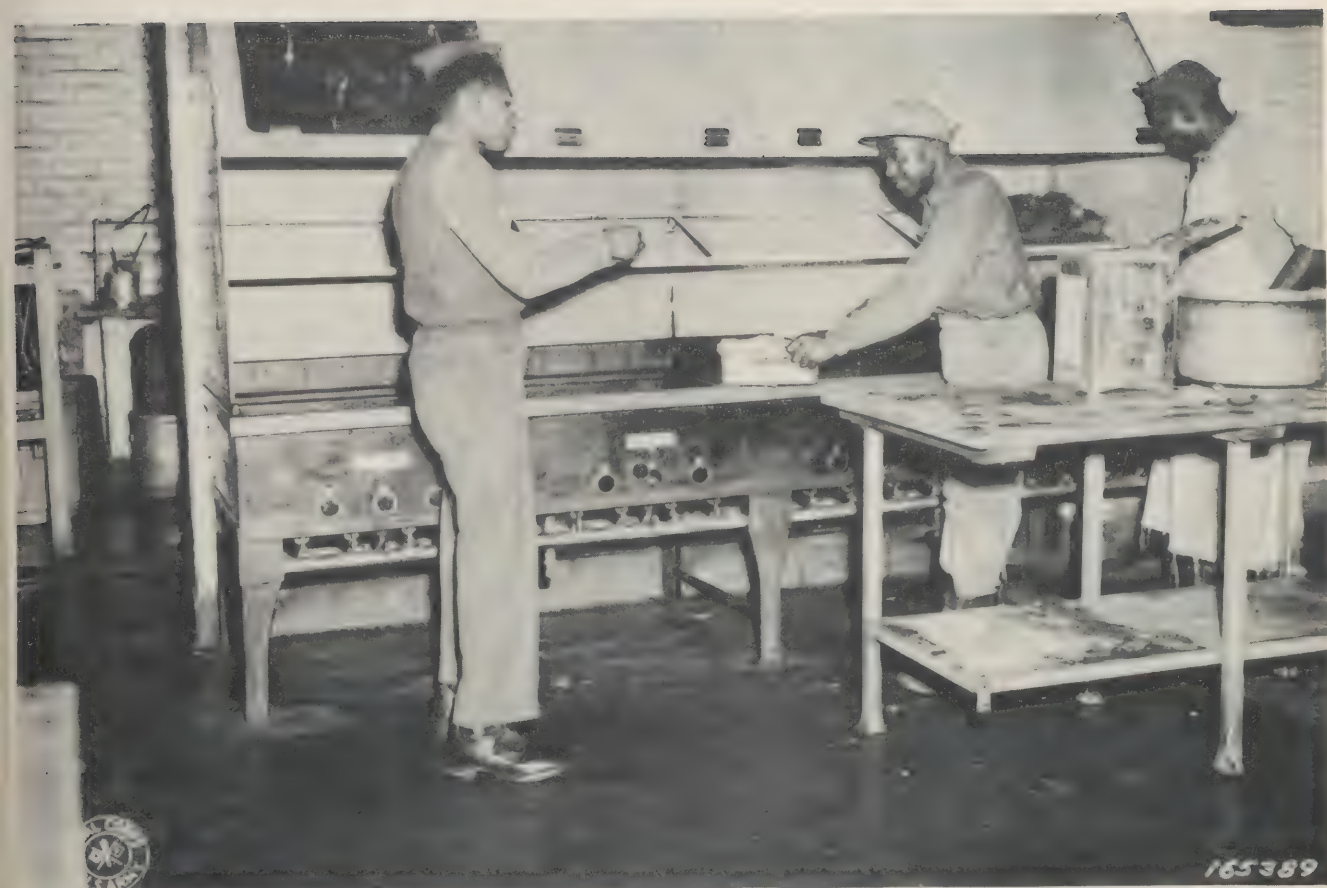


Figure 12

Preparation of salmon croquets in a mess, England, December 1942





Sonne variety was determined most frequently among epidemics in Great Britain. That was also true for outbreaks on the continent, although to a lesser extent. Other identified types included the Flexner strains, Boyd 103, and type ambigua. The Shiga dysentery bacillus was not known to have been demonstrated in any outbreak of this series, although the limited laboratory facilities in many instances permitted no more than species differentiation.

The mortality from bacillary dysentery was exceedingly low, 0.0003 per thousand per annum, with only one death, this occurring in June 1945. For dysentery of all forms, there were 43 deaths among American troops serving in Europe in the previous war. In World War II there were two.





Table 1

Admissions and Deaths for Diarrheas and Dysenteries  
Including Gastroenteritis

With rates per 1000 per annum in  
Certain Major Wars of the United States

U. S. Wars	Time	Cases		Deaths	
		Number	Rate	Number	Rate
Civil War	May 1861- July 1865	1,755,389 <sup>a</sup>	741.2	46,277 <sup>b</sup>	18.0
Spanish-American	1898-1901	204,040 <sup>d</sup>	426.0	1,595 <sup>b</sup>	3.3
World-War I In Europe (excluding Russia)	April 1917- Dec. 1919	48,202 <sup>c</sup>	28.9	208 <sup>b</sup>	0.13
World-War II in Europe (excluding Iceland)	Feb. 1942- June 1945	44,479	14.0	5	0.00157

a. Admissions to field medical installations and all deaths.

b. All deaths.

c. Hospital admissions only after 15 June 1918.

d. Hospital and quarters admissions.

Source: Division of Medical Statistics, Office of The Surgeon General,  
War Department, Washington, D. C.

Table 2.

Intestinal Infections Including Common Diarrhea and Dysentery (All Types)  
 Peace Time Army in Continental United States  
 Number of cases and rates per 1000 strength per annum, by months  
 1935 - 1939 Inclusive

Month	Total		1935		1936		1937		1938		1939	
	Cases	Rate	Cases	Rate	Cases	Rate	Cases	Rate	Cases	Rate	Cases	Rate
January	102	2.0	12	1.6	18	2.0	19	1.5	23	2.1	30	2.9
February	63	1.3	7	0.9	9	0.8	12	1.2	20	1.9	15	1.5
March	130	2.5	22	2.4	14	1.5	15	1.5	52	5.0	27	2.1
April	81	1.6	17	2.3	9	1.0	8	0.8	28	2.2	19	1.8
May	90	1.7	16	2.1	14	1.3	14	1.1	22	2.1	24	2.3
June	136	2.6	18	2.0	16	1.7	38	3.7	27	2.6	37	2.8
July	200	3.7	14	1.8	16	1.7	51	4.1	39	3.0	80	7.3
August	334	6.3	52	5.1	81	7.1	119	12.0	40	3.8	42	3.9
September	254	4.6	56	6.6	54	5.7	41	4.0	50	3.8	53	3.9
October	188	3.4	19	2.2	84	7.1	17	1.3	33	3.2	35	3.0
November	186	3.5	16	1.5	10	1.0	104	10.0	23	2.2	33	2.7
December	121	2.0	13	1.5	11	1.1	51	4.0	17	1.3	29	1.8
Total	1885	3.0	262	2.5	336	2.8	489	3.6	374	2.8	424	2.9

Source: Division of Medical Statistics, Office of The Surgeon General, War Department,  
 Washington, D. C.

Table 3

Intestinal Infections Including Common Diarrhea  
and Dysentery (All Types)

Pre-War Army, Compulsory Military Service,  
in Continental United States

Number of cases and rates per 1000 strength  
per annum, by months

1940 - 1941 Inclusive

Month	Total		1940		1941	
	Cases	Rate	Cases	Rate	Cases	Rate
January	156	2.3	15	1.1	141	2.6
February	163	2.3	18	1.2	145	2.5
March	255	2.9	47	2.6	208	2.9
April	195	2.0	9	0.6	186	2.2
May	447	3.5	27	1.6	420	3.8
June	2212	20.3	61	4.2	2151	22.8
July	1494	13.0	28	1.7	1466	14.6
August	4664	30.0	205	8.2	4459	34.5
September	3984	32.0	146	6.5	3838	37.4
October	2207	14.0	185	6.1	2022	15.7
November	1837	12.1	847	19.4	990	9.2
December	824	5.8	286	7.6	538	5.1
Total	18438	13.0	1874	7.0	16564	14.5

Source: Division of Medical Statistics, Office of  
The Surgeon General, War Department,  
Washington, D. C.



Table 4

Intestinal Infections Including Common Diarrhea  
and Dysentery (All Types)

War Time Army in Continental United States

Number of cases and rates per 1000 strength  
per annum, by months

January 1942 - June 1945 Inclusive

Month	Total		1942		1943		1944		1945	
	Cases	Rate	Cases	Rate	Cases	Rate	Cases	Rate	Cases	Rate
January	7772	6.7	663	4.7	2187	5.1	3296	9.0	1626	7.0
February	7384	6.8	601	4.6	1848	5.0	3220	9.1	1715	7.7
March	7265	5.9	526	3.6	1961	5.1	3120	7.3	1658	6.2
April	7522	6.3	509	3.2	3627	7.3	2131	6.4	1255	5.8
May	8485	7.3	915	4.3	3767	9.3	2436	7.5	1367	6.2
June	15415	12.1	1340	7.1	7433	18.2	4611	11.6	2031	7.1
July	19960	18.8	3003	12.1	13235	26.2	3722	12.1		
August	13018	14.2	2126	10.0	7664	19.0	3228	10.8		
September	12371	12.5	3133	13.8	5542	13.9	3696	10.2		
October	10295	9.6	2803	9.1	4761	9.7	2731	10.0		
November	7134	7.8	1841	6.7	3274	8.6	2019	7.8		
December	8159	7.6	1614	5.5	4212	7.0	2333	7.6		
Total	124780	9.5	19074	7.5	59511	11.6	36543	9.2	9652	6.7

Source: Division of Medical Statistics, Office of The Surgeon General, War  
Department, Washington, D. C.

Table 5

## The Diarrheas and Dysenteries,

Troops of the United States Army in Theaters of Operations and in Continental United States  
Cases and Rates per 1000 Strength per Annum, by Months, January 1942 to June 1945

Theater	Total		1942		1943		1944		1945	
	Cases	Rate	Cases	Rate	Cases	Rate	Cases	Rate	Cases	Rate
Total Army	464292	22	34320	11	465186	25	169015	23	95771	25
United States	124900	10	19074	8	59511	12	36543	9	9772	7
Overseas	339392	42	15246	30	105675	66	132472	38	85999	35
China-Burma-India	47976	144	699	123	6706	146	28850	181	11721	97
Africa-Middle East	17370	133	1124	196	9069	170	5427	115	1750	73
Southwest Pacific	88842	74	3965	59	13627	70	30710	55	40540	104
Mediterranean	98762	73	719	34	57006	132	35798	54	5239	22
Pacific Ocean Area	33001	32	4968	34	12580	43	10949	28	4504	22
Latin America	6867	20	2146	21	2557	21	1477	17	687	18
European	44479	14	1240	17	3082	12	18720	13	21437	16
Alaska	1415	5	240	5	890	8	248	3	37	2
North America	680	4	145	4	158	2	293	7	84	5

Source: Division of Medical Statistics, Office of The Surgeon General, War Department, Washington, D. C.

Table 6

## Intestinal Infections, Including Common Diarrheas and Dysenteries (All Types)

## United States Army, European Theater of Operations

Cases and rates per 1000 strength per annum, by months  
February 1942 - June 1945 Inclusive

Month	Total		1942		1943		1944		1945	
	Cases	Rate	Cases	Rate	Cases	Rate	Cases	Rate	Cases	Rate
January	4349	16.2			161	14.7	777	12.6	3411	17.4
February	5096	17.9	6	19.5	136	16.1	747	10.6	4207	20.4
March	4594	12.2	9	11.4	86	10.4	1084	10.5	3415	12.9
April	4685	14.5	0	0	82	7.8	1221	13.1	3382	15.5
May	4834	14.5	3	1.4	260	27.6	1112	11.1	3459	15.6
June	4580	11.3	31	8.7	68	5.6	918	7.2	3563	13.5
July	1183	8.8	44	6.9	185	9.7	954	8.8		
August	1506	9.7	93	10.6	198	10.2	1215	9.6		
September	2632	13.2	314	24.8	274	11.7	2044	12.5		
October	2627	13.6	427	25.5	518	14.1	1682	12.1		
November	2599	12.7	214	19.2	311	7.6	2074	13.6		
December	5794	19.3	99	10.6	803	12.3	4892	21.6		
Total	44479	14.0	1240	17.0	3082	11.7	18720	12.7	21437	15.6

Source: Division of Medical Statistics, Office of The Surgeon General, War Department, Washington, D. C.



Table 7

Intestinal Infections, Including Common Diarrheas  
and Dysenteries (All Types)

All Forces, Air Forces, Ground Forces and  
Communications Zone, United Kingdom

Rate per 1000 strength per annum, by weeks

1 January 1943 to 30 June 1944

Week Ending	All Forces E.T.O.	Services of Supply	Air Forces	Ground Forces
1 January 1943	8	9	3	5
8 January 1943	9	8	10	6
15 January 1943	10	16	5	6
22 January 1943	13	20	7	17
29 January 1943	12	25	4	3
5 February 1943	12	20	6	14
12 February 1943	9	17	3	6
19 February 1943	9	13	7	6
26 February 1943	9	9	9	8
5 March 1943	8	*	*	*
12 March 1943	10	12	2	20
19 March 1943	7	12	1	3
26 March 1943	8	14	1	9
2 April 1943	6	5	0	2
9 April 1943	8	12	5	6
16 April 1943	11	16	5	6
23 April 1943	10	19	4	3
30 April 1943	5	9	0	0
7 May 1943	36	76	6	6
14 May 1943	23	49	5	8
21 May 1943	5	9	2	0
28 May 1943	5	11	2	0
4 June 1943	6	10	5	0
11 June 1943	5	11	2	0
18 June 1943	6	11	5	0
25 June 1943	3	4	1	17
2 July 1943	6	*	*	*
9 July 1943	7	7	9	3
16 July 1943	7	12	2	7
23 July 1943	10	22	3	3
30 July 1943	14	20	10	0
6 August 1943	11	24	2	7
13 August 1943	7	16	1	6
20 August 1943	5	7	1	19
27 August 1943	8	17	4	0
3 September 1943	19	12	10	86
10 September 1943	12	24	6	4
17 September 1943	13	16	4	31
24 September 1943	8	9	5	15

Table 7 Cont'd.

Intestinal Infections, Including Common Diarrheas  
and Dysenteries (All Types)

All Forces, Air Forces, Ground Forces and  
Communications Zone, United Kingdom

Rate per 1000 strength per annum, by weeks

1 January 1943 to 30 June 1944

Week Ending		All Forces E.T.O.	Services of Supply	Air Forces	Ground Forces
1 October	1943	11	18	4	14
8 October	1943	15	*	*	53
15 October	1943	5	5	3	10
22 October	1943	6	6	5	7
29 October	1943	5	8	3	2
5 November	1943	7	12	3	3
12 November	1943	5	8	4	4
19 November	1943	8	6	3	20
26 November	1943	10	20	3	8
3 December	1943	7	5	3	13
10 December	1943	10	8	9	15
17 December	1943	10	10	12	7
24 December	1943	15	8	8	31
31 December	1943	8	10	6	9
7 January	1944	17	28	12	8
14 January	1944	10	10	11	10
21 January	1944	8	8	7	7
28 January	1944	15	14	5	28
4 February	1944	18	11	11	5
11 February	1944	11	3	21	4
18 February	1944	10	10	6	5
25 February	1944	10	7	8	7
3 March	1944	16	16	13	6
10 March	1944	10	6	14	4
17 March	1944	11	9	10	6
24 March	1944	8	5	9	7
31 March	1944	7	5	9	2
7 April	1944	12	21	8	12
14 April	1944	26	17	11	5
21 April	1944	14	21	6	3
28 April	1944	16	10	7	2
5 May	1944	10	3	5	3
12 May	1944	14	18	9	10
19 May	1944	11	20	10	3
26 May	1944	11	14	15	2
2 June	1944	8	11	5	2
9 June	1944	6	5	5	5
16 June	1944	9	10	6	12
23 June	1944	7	6	8	6
30 June	1944	6	3	6	3

\* Data not available

Source: Medical Records Division, Office of the Chief  
Surgeon, European Theater of Operations.

Table 8

## Intestinal Infections, Including Common Diarrheas and Dysenteries (All Types)

All Forces, Ground Forces, Air Forces and Communications Zone, European Continent Only

Rates per thousand strength per annum, by weeks

23 June 1944 - 29 June 1945

Week Ending	Continental ETC	Ground Forces	Air Forces	Com. Zone	Week Ending	Continental ETC	Ground Forces	Air Forces	Com. Zone
23 June 1944	*	9	*	*	29 Dec 1944	20	19	20	30
30 June 1944	*	12	*	*	5 Jan 1945	20	18	6	30
7 July 1944	*	7	*	*	12 Jan 1945	19	23	6	17
14 July 1944	*	4	*	11	19 Jan 1945	19	22	6	19
21 July 1944	*	5	*	1	26 Jan 1945	20	21	3	20
28 July 1944	*	5	*	2	2 Feb 1945	20	23	3	17
4 Aug 1944	*	3	*	5	9 Feb 1945	30	31	7	25
11 Aug 1944	9	4	*	1	16 Feb 1945	24	26	6	13
18 Aug 1944	16	3	*	10	23 Feb 1945	22	27	5	25
25 Aug 1944	16	4	*	8	2 Mar 1945	15	21	5	14
1 Sep 1944	17	7	*	11	9 Mar 1945	17	16	13	10
8 Sep 1944	11	7	*	22	16 Mar 1945	17	19	6	10
15 Sep 1944	11	8	*	13	23 Mar 1945	14	12	6	15
22 Sep 1944	10	15	14	10	30 Mar 1945	13	10	4	10
29 Sep 1944	18	10	11	25	6 Apr 1945	16	9	5	12
6 Oct 1944	14	12	6	13	13 Apr 1945	17	11	5	12
13 Oct 1944	18	14	8	16	20 Apr 1945	21	12	6	12
20 Oct 1944	14	13	8	15	27 Apr 1945	15	10	6	18
27 Oct 1944	14	11	12	15	4 May 1945	13	8	3	10
3 Nov 1944	17	11	4	29	11 May 1945	19	12	2	25
10 Nov 1944	15	10	9	18	18 May 1945	17	17	7	20
17 Nov 1944	17	15	9	24	25 May 1945	19	15	7	21
24 Nov 1944	16	20	17	13	1 June 1945	15	14	5	11
1 Dec 1944	22	30	8	11	8 June 1945	16	18	8	13
8 Dec 1944	29	33	72	13	15 June 1945	13	10	2	12
15 Dec 1944	31	38	11	22	22 June 1945	17	11	11	21
22 Dec 1944	21	19	7	21	29 June 1945	19	12	10	25

\*Data not available.

Source: Medical Records Division, Office of the Chief Surgeon, European Theater of Operations.



Table 9

Intestinal Infections, Including Common Diarrheas  
and Dysenteries (All types)

United Kingdom and Continental Europe

Rates per thousand strength per annum, by weeks

23 June 1944 - 29 June 1945

Week Ending	United Kingdom	Continental Europe	Week Ending	United Kingdom	Continental Europe
23 June 1944	7	*	29 Dec 1944	10	20
30 June 1944	6	*	5 Jan 1945	14	20
7 July 1944	4	*	12 Jan 1945	7	19
14 July 1944	12	*	19 Jan 1945	5	19
21 July 1944	10	*	26 Jan 1945	7	20
28 July 1944	9	*	2 Feb 1945	7	20
4 Aug 1944	10	*	9 Feb 1945	11	30
11 Aug 1944	10	9	16 Feb 1945	6	24
18 Aug 1944	18	16	23 Feb 1945	27	22
25 Aug 1944	11	16	2 Mar 1945	4	15
1 Sep 1944	18	17	9 Mar 1945	5	17
8 Sep 1944	12	11	16 Mar 1945	24	17
15 Sep 1944	6	11	23 Mar 1945	5	14
22 Sep 1944	11	10	30 Mar 1945	3	13
29 Sep 1944	6	18	6 Apr 1945	6	16
6 Oct 1944	4	14	13 Apr 1945	36	17
13 Oct 1944	8	18	20 Apr 1945	4	21
20 Oct 1944	3	14	27 Apr 1945	4	15
27 Oct 1944	11	14	4 May 1945	3	13
3 Nov 1944	3	17	11 May 1945	3	19
10 Nov 1944	3	15	18 May 1945	6	17
17 Nov 1944	6	17	25 May 1945	3	19
24 Nov 1944	5	16	1 June 1945	4	15
1 Dec 1944	16	22	8 June 1945	4	16
8 Dec 1944	9	29	15 June 1945	3	13
15 Dec 1944	19	31	22 June 1945	4	17
22 Dec 1944	11	21	29 June 1945	3	19

\*Data not available.

Source: Medical Records Division, Office of the Chief Surgeon,  
European Theater of Operations.

Table 10

Intestinal Infections, Including Common Diarrheas  
and Dysenteries (All types)

Air Forces, U. S. Army, European Continent and United Kingdom

Rates per thousand strength per annum, by weeks

23 June 1944 - 29 June 1945

Week Ending	United Kingdom	Continental Europe	Week Ending	United Kingdom	Continental Europe
23 June 1944	8	*	29 Dec 1944	8	20
30 June 1944	6	*	5 Jan 1945	4	6
7 July 1944	4	*	12 Jan 1945	6	6
14 July 1944	8	*	19 Jan 1945	6	6
21 July 1944	4	*	26 Jan 1945	7	3
28 July 1944	7	*	2 Feb 1945	7	3
4 Aug 1944	4	*	9 Feb 1945	14	7
11 Aug 1944	14	*	16 Feb 1945	5	6
18 Aug 1944	13	*	23 Feb 1945	12	5
25 Aug 1944	2	*	2 Mar 1945	5	5
1 Sep 1944	17	*	9 Mar 1945	4	13
8 Sep 1944	15	*	16 Mar 1945	6	6
15 Sep 1944	6	*	23 Mar 1945	5	6
22 Sep 1944	9	14	30 Mar 1945	4	4
29 Sep 1944	8	11	6 Apr 1945	5	5
6 Oct 1944	3	6	13 Apr 1945	4	5
13 Oct 1944	4	8	20 Apr 1945	4	6
20 Oct 1944	5	8	27 Apr 1945	4	6
27 Oct 1944	2	12	4 May 1945	5	3
3 Nov 1944	3	4	11 May 1945	2	2
10 Nov 1944	4	9	18 May 1945	4	7
17 Nov 1944	6	9	25 May 1945	3	7
24 Nov 1944	5	17	1 June 1945	5	5
1 Dec 1944	6	8	8 June 1945	5	8
8 Dec 1944	17	72	15 June 1945	2	2
15 Dec 1944	6	11	22 June 1945	5	11
22 Dec 1944	9	7	29 June 1945	4	10

\*Data not available.

Source: Medical Records Division, Office of the Chief Surgeon,  
European Theater of Operations.

Table 11

## Intestinal Infections, Including Common Diarrheas and Dysenteries (All Types)

White and Colored Troops, United Kingdom and European Continent

Rates per 1000 strength per annum, by weeks

9 July 1943 to 29 June 1945

United Kingdom			European Continent		
Week Ending	White	Colored	Week Ending	White	Colored
9 July 1943	8	0	1 September 1944	19	2
16 July 1943	7	0	8 September 1944	12	2
23 July 1943	10	5	15 September 1944	12	4
30 July 1943	14	0	22 September 1944	11	4
6 August 1943	12	0	29 September 1944	18	24
13 August 1943	7	6	6 October 1944	15	6
20 August 1943	5	7	13 October 1944	19	7
27 August 1943	9	6	20 October 1944	15	4
3 September 1943	20	6	27 October 1944	15	3
10 September 1943	10	36	3 November 1944	18	7
17 September 1943	13	7	10 November 1944	16	6
24 September 1943	8	2	17 November 1944	19	4
1 October 1943	12	2	24 November 1944	18	5
8 October 1943	*	*	1 December 1944	23	6
15 October 1943	6	0	8 December 1944	32	4
22 October 1943	7	6	15 December 1944	33	9
29 October 1943	5	3	22 December 1944	22	10
5 November 1943	6	16	29 December 1944	18	42
12 November 1943	6	1	5 January 1945	20	20
19 November 1943	8	4	12 January 1945	20	8
26 November 1943	11	3	19 January 1945	20	13
3 December 1943	6	0	26 January 1945	22	8
10 December 1943	11	0	2 February 1945	21	7
17 December 1943	11	0	9 February 1945	32	10
24 December 1943	16	0	16 February 1945	24	20
31 December 1943	9	3	23 February 1945	23	12
7 January 1944	18	3	2 March 1945	*	*
14 January 1944	11	3	9 March 1945	18	4
21 January 1944	8	3	16 March 1945	18	4
28 January 1944	16	0	23 March 1945	15	5
4 February 1944	19	2	30 March 1945	14	5
11 February 1944	11	6	6 April 1945	17	5
18 February 1944	11	3	13 April 1945	18	3
25 February 1944	10	4	20 April 1945	22	7
3 March 1944	16	3	27 April 1945	16	9



Table 11 Cont'd.

Intestinal Infections, Including Common Diarrheas and Dysenteries (All Types)

White and Colored Troops, United Kingdom and European Continent

Rates per 1000 strength per annum, by weeks

9 July 1943 to 29 June 1945

United Kingdom				European Continent		
Week Ending		White	Colored	Week Ending		Colored
10 March	1944	10	5	4 May	1945	*
17 March	1944	11	6	11 May	1945	20
24 March	1944	8	4	18 May	1945	18
31 March	1944	7	3	25 May	1945	20
7 April	1944	13	4	1 June	1945	15
14 April	1944	27	7	8 June	1945	17
21 April	1944	14	4	15 June	1945	14
28 April	1944	17	3	22 June	1945	17
5 May	1944	10	4	29 June	1945	20
12 May	1944	14	1			
19 May	1944	12	1			
26 May	1944	12	2			
2 June	1944	9	0			
9 June	1944	6	2			
16 June	1944	8	13			
23 June	1944	7	8			
30 June	1944	6	1			

\*Data not available.

Source: Medical Records Division, Office of the Chief Surgeon,  
European Theater of Operations.

Table 12

Intestinal Infections, Including Common Diarrheas and Dysenteries (All Types)  
 First, Third, Seventh and Ninth Armies, European Theater of Operations  
 Rates per thousand strength per annum by weeks  
 9 June 1944 - 29 June 1945

Week Ending	First Army	Third Army	Seventh Army	Ninth Army	Week Ending	First Army	Third Army	Seventh Army	Ninth Army
9 June 1944	Entered				22 Dec 1944	13	20	54	3
16 June 1944	Combat				29 Dec 1944	13	15	39	5
23 June 1944	8				5 Jan 1945	11	15	35	9
30 June 1944	5				12 Jan 1945	30	16	35	11
7 July 1944	5				19 Jan 1945	26	20	28	8
14 July 1944	4				26 Jan 1945	44	22	32	6
21 July 1944	5				2 Feb 1945	16	23	41	7
28 July 1944	6				9 Feb 1945	26	50	37	14
4 Aug 1944	4	Entered			16 Feb 1945	25	39	29	11
11 Aug 1944	5	Combat	Entered		23 Feb 1945	13	49	34	11
18 Aug 1944	12	2	Entered		2 Mar 1945	16	29	20	15
25 Aug 1944	15	4	Combat	Entered	9 Mar 1945	11	32	20	6
1 Sep 1944	7	7	29*	Combat	16 Mar 1945	14	23	16	10
8 Sep 1944	10	6	54		23 Mar 1945	15	8	19	9
15 Sep 1944	6	7	77		30 Mar 1945	7	6	14	6
22 Sep 1944	9	5	50		6 Apr 1945	9	7	14	5
29 Sep 1944	16	11	55		13 Apr 1945	10	7	29	13
6 Oct 1944	17	7	64		20 Apr 1945	10	7	16	10
13 Oct 1944	21	6	65		27 Apr 1945	12	6	14	8
20 Oct 1944	20	10	55		4 May 1945	15	6	23	6
27 Oct 1944	13	7	61		11 May 1945	6	6	27	5
3 Nov 1944	13	11	71		18 May 1945	Relieved	9	48	10
10 Nov 1944	12	8	60	16	25 May 1945		15	33	7
17 Nov 1944	12	13	41	5	1 June 1945		8	40	6
24 Nov 1944	14	11	35	5	8 June 1945		8	57	6
1 Dec 1944	20	23	31	12	15 June 1945		15	6	Relieved
8 Dec 1944	26	43	51	13	22 June 1945		11	11	
15 Dec 1944	23	29	48	3	29 June 1945		13	11	
	19	26	65	4					

\*Landed Southern France 15 August 1944 under MTOUSA Command; Assigned ETOUSA 1 November 1944.

European Theater of Operations

Table 13

Serologic Types of Dysentery Bacilli from  
Stool Examinations of 187 Patients

Seventh U. S. Army

December 1944

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Flexner I	1
Flexner II	4
Flexner IV	2
Flexner V	9
Flexner VI	1
Boyd 274	1
S. ambigua	4
Sonne	<u>2</u>
Total	24

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Source: Annual Report of Medical Department Activities, Seventh Army, 1944.



Table 14

Diarrheas and Dysenteries

Prisoners of War

European Theater of Operations, Continent Only

Cases and rates per 1000 strength  
per annum, by months

September 1944 to June 1945

Month	Cases	Rate
1944 September	360	145.3
October	1,070	184.5
November	2,215	142.3
December	2,367	185.4
1945 January	1,923	120.6
February	2,198	123.3
March	3,066	101.8
April	4,713	74.6
May	80,952	734.6
June	60,978	326.9
Total	159,842	349.2

Source: Division of Preventive Medicine,  
Office of the Chief Surgeon,  
European Theater of Operations.

Table 15

The Common Diarrheas  
The European Theater of Operations, U. S. Army  
Cases and rates per 1000 strength per annum, by months  
February 1942 - June 1945 Inclusive

Month	Total		1942		1943		1944		1945	
	Cases	Rate	Cases	Rate	Cases	Rate	Cases	Rate	Cases	Rate
January	3979	14.8			122	11.1	721	11.7	3136	16.0
February	4710	16.5	6	19.5	87	10.3	712	10.1	3905	19.0
March	4163	11.0	9	11.4	80	9.7	994	9.6	3080	11.6
April	4219	13.1	0	0	80	7.6	1174	12.6	2965	13.5
May	4518	13.5	3	1.4	258	27.3	1074	10.7	3183	14.4
June	4288	10.6	31	8.7	64	5.3	839	6.6	3354	12.7
July	1060	7.9	44	6.9	170	8.9	846	7.8		
August	1383	8.9	82	9.3	187	9.7	1114	8.8		
September	2363	11.8	295	23.3	270	11.6	1798	11.0		
October	2482	12.9	423	25.3	505	13.8	1554	11.2		
November	2379	11.6	185	16.6	303	7.4	1891	12.4		
December	5406	18.0	94	10.1	764	11.7	4548	20.1		
Total	40950	12.9	1172	16.1	2890	10.9	17265	11.7	19623	14.3

Source: Division of Medical Statistics, Office of The Surgeon General, War Department, Washington, D. C.

Table 16

The Dysenteries

The European Theater of Operations, U. S. Army

Cases and Rates per 1000 per annum, by types

February 1942 - June 1945 Inclusive

Type	Total		1942*		1943*		1944		1945	
	Cases	Rate	Cases	Rate	Cases	Rate	Cases	Rate	Cases	Rate
Dysentery, bacillary	1054	.4					500	.3	554	.4
Dysentery, amebic	780	.3					336	0.2	444	.3
Dysentery, unclassified	1435	.5					619	.4	816	.6
Total	3529	1.1	68	.9	192	.7	1455	1.0	1814	1.3

\*Types not recorded.

Source: Division of Medical Statistics, Office of The Surgeon General, War  
Department, Washington, D. C.



Table 17

The Dysenteries, All Forms  
The European Theater of Operations, U. S. Army  
Cases and rates per 1000 strength per annum, by months  
February 1942 - June 1945

Month	Total		1942		1943		1944		1945	
	Cases	Rate	Cases	Rate	Cases	Rate	Cases	Rate	Cases	Rate
January	370	1.4			39	3.6	56	.9	275	1.4
February	386	1.4	-		49	5.8	35	.5	302	1.4
March	431	1.1	-		6	.7	90	.9	335	1.3
April	466	1.4	-		2	.2	47	.5	417	2.0
May	316	.9	-		2	.2	38	.4	276	1.2
June	292	.7	-		4	.3	79	.6	209	.8
July	123	.9	-		15	.8	108	1.0		
August	123	.8	11	1.3	11	.6	101	.8		
September	269	1.3	19	1.5	4	.2	246	1.5		
October	145	.8	4	.2	13	.4	128	.9		
November	220	1.1	29	2.6	8	.2	183	1.2		
December	388	1.3	5	.5	39	.6	344	1.5		
Total	3529	1.1	68	.9	192	.7	1455	1.0	1814	1.3

Source: Medical Statistics Division, Office of The Surgeon General, War Department,  
Washington, D. C.

Table 18

Amebic Dysentery

The European Theater of Operations, U. S. Army

Cases and rates per 1000 strength per annum, by months

January 1944 - June 1945\*

Month	Total		1944		1945	
	Cases	Rate	Cases	Rate	Cases	Rate
January	86	0.3	14	0.2	72	0.4
February	92	0.3	6	0.1	86	0.4
March	119	0.3	17	0.2	102	0.4
April	85	0.3	21	0.2	64	0.3
May	76	0.2	19	0.2	57	0.3
June	109	0.3	46	0.4	63	0.2
July	18	0.2	18	0.2		
August	13	0.1	13	0.1		
September	17	0.1	17	0.1		
October	41	0.3	41	0.3		
November	27	0.2	27	0.2		
December	97	0.4	97	0.4		
Total	780	0.3	336	0.2	444	0.3

\*Types not recorded until January 1944.

Source: Medical Statistics Division, Office of The Surgeon General, War Department, Washington, D. C.

Table 19

Epidemic Diarrhea in the 5th Infantry Division  
19th, 46th, and 50th Field Artillery Battalions  
1944

Week Ending	Total	46th FA	50th FA	19th FA
January 7	32	23	5	4
14	55	25	15	15
21	30	18	4	8
28	20	7	6	7
February 4	14	5	6	3
11	23	4	2	17
18	18	4	2	12
25	13	10	0	3
March 3	11	3	2	6
10	53	15	21	17
17	161	39	50	72
24	52	10	12	30
31	31	10	9	12
April 7	14	2	2	10
14	16	5	2	9
Total	543	180	138	225

Source: Division of Preventive Medicine,  
Office of The Chief Surgeon, ETO.



Table 20

Bacillary Dysentery

The European Theater of Operations, U. S. Army

Cases and rates per 1000 strength per annum, by months

January 1944 - June 1945\*

Month	Total		1944		1945	
	Cases	Rate	Cases	Rate	Cases	Rate
January	113	0.4	18	0.3	95	0.5
February	80	0.3	8	0.1	72	0.3
March	116	0.3	34	0.3	82	0.3
April	224	0.7	14	0.2	210	1.0
May	41	0.1	4	0.04	37	0.2
June	69	0.2	11	0.1	58	0.2
July	58	0.5	58	0.5		
August	30	0.2	30	0.2		
September	97	0.6	97	0.6		
October	26	0.2	26	0.2		
November	96	0.6	96	0.6		
December	104	0.5	104	0.5		
Total	1054	0.4	500	0.3	554	0.4

\*Types not recorded until January 1944.

Source: Medical Statistics Division, Office of The Surgeon General, War Department, Washington D. C.

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A HISTORY OF PREVENTIVE MEDICINE  
IN THE  
EUROPEAN THEATER OF OPERATIONS  
UNITED STATES ARMY  
1941 - 1945

PART III - Epidemiology  
Section 2 - Intestinal Infections  
Number 2 - Food Poisoning

by

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## PART III

### Epidemiology

#### Section 2 - Intestinal Infections

Food Poisoning.--Food poisoning became a reportable condition in the European Theater in February 1944. This new term was introduced into the schedule of the reportable diseases because of the commonly existing interpretation that if an outbreak of intestinal infection was definitely food poisoning, it need not be reported under common diarrheas. Such outbreaks were often not reported at all.

Food poisoning is a collective term including a number of clinical conditions. It may arise from actual poisoning, through heavy metals gaining entrance to food from utensils in the course of preparation, or by direct addition, accidentally or otherwise, of any organic or inorganic poison. This factor has little or no importance in a general consideration of food poisoning in military practice. It ranks no higher than a curiosity. The same holds true for toxic effects resulting from poisonous plants and animals. The bulk of food poisoning comes from contamination of food with pathogenic bacteria in the course of preparation or serving. Very little food poisoning arises from basic contamination of food ingredients, or spoilage in the popular sense. Two principle forms of bacterial food borne disease are to be distinguished, the intoxications and the true infections.

Classification.--Food intoxications arise from ingestion of preformed bacterial poisons,--toxins which have developed in the food through action of contaminating bacteria. Many of these bacteria are not of themselves injurious when taken into the intestinal tract of man. They do not lead to infection of the host. Their bacterial toxins, if they gain entrance in sufficient amounts in the preformed state, are capable of producing serious disease processes.

The infections depend for their action on the production of an actual infectious disease of the host, having a recognized incubation period and a relatively prolonged clinical course. When food is involved in the transmission of typhoid fever, the dysenteries, and other recognized intestinal infections, the mechanism is termed food-borne infection. Food poisoning of the type of an infection is limited essentially to the activities of the various members of the Salmonella group of bacteria. This follows from lack of precise knowledge of how much of the affect produced by these bacteria is due to preformed toxin, and how much to actual invasion of the host.



Incidence of Food Poisoning.--The data on food poisoning presented in Table I includes all varieties of that condition, both intoxications and infections, that were reported in the European Theater from February 1944 to the end of hostilities. Separate records of types of food poisoning by clinical difference or by specific etiologic agent were not maintained. Neither was distinction made between cases where identification of the infectious agent was accomplished, and those that were dependent upon epidemiologic information alone for recognition as food poisoning.

The seasonal variations are ill-defined because of the small numbers, but in general show a fairly close parallelism with those of the common diarrheas.

A comparison of the data of Table I and those of Table 15, Section 2, Number 1, is not to be taken as an indication of the relative frequency of food poisoning and the common diarrheas in this experience. The differences represent more a matter of custom and practice in reporting than of actual occurrence. It was brought out in the discussion of the common diarrheas that the great proportion of those diseases were in all probability food poisoning. The numbers of cases included in Table I are small, and on the basis of knowledge of field conditions fall far short of representing actual incidence. For purposes of comparing the behavior of the common diarrheas with previous experience, the two categories of diarrhea and food poisoning as presented in this discussion should be combined.

A better understanding of the actual prevalence of food poisoning was obtained by summarizing a series of special epidemiologic reports submitted by unit surgeons to the Chief Surgeon of the theater. These reports were requested by the preventive medicine service at theater headquarters for all outbreaks of any significance or importance. It will be appreciated that satisfactory information was not available in all instances, either because the proper investigation had not been made at the time of the incident, or because the circumstances were too obscure to lead to reasonable conclusions.

Some 115 epidemics of appreciable extent are presented in Table 2. The series is selected in that it includes only epidemics occurring during the time these special reports were required, and only those instances where data were sufficiently definite to be of value. Seventeen of the outbreaks were confirmed as due to staphylococci, either by isolation of the pathogenic agent from the food or from patients, or from both. Sixteen epidemics were established as due to a member of the Salmonella group of intestinal bacteria, sometimes by isolation of the agent from the food, but more commonly

from the feces or blood of patients. The great majority, 82 in all, were unconfirmed bacteriologically; but on the basis of clinical and epidemiologic evidence, 44 were considered to be of the staphylococcus type, and 16 others in all probability due to salmonella. For 22 epidemics the observations were either so indefinite or of conflicting nature as to resemble neither of the two principal recognized types. They are set forth in the table as indeterminate.

Staphylococcus Food Poisoning.--That an understanding may be had of the clinical nature of those forms of food poisoning where staphylococci were isolated, and more particularly of those considered as probably of staphylococcus type in the absence of bacteriological identification, the general clinical aspects are outlined, based on observation of patients in a number of epidemics.

The symptoms appeared in about three hours, occasionally in from one to six hours, after ingestion of food containing the enterotoxin. The incubation period was apparently influenced by the amount of enterotoxin consumed and the susceptibility of the individual. Usually the first symptom observed was salivation, which was subsequently followed by nausea, vomiting, retching, abdominal cramping of varying severity, and diarrhea. In severe cases, blood and mucus were not uncommonly observed in the stools and vomitus. In mild cases, nausea and vomiting occurred without diarrhea; or there was nausea and diarrhea without vomiting. Headache, muscular cramps and sweating often occurred if symptoms were moderately severe. Marked prostration accompanied the vomiting and diarrhea in severe cases. In such instances, fever was sometimes present, or more commonly the temperature was subnormal. Staphylococcus food poisoning in otherwise normal individuals was not fatal and recovery was usually rapid, in from one to three days. Some patients, however, had not completely recovered after a week or more. Individuals varied considerably in their susceptibility to the enterotoxin.

Frequency of Epidemics.--Satisfactory records of the clinical form of food poisoning became available for 115 outbreaks. Staphylococci were deemed responsible for 60, or 52 percent. If the computation is based on only those outbreaks in which a specific etiologic agent was demonstrated, 33, the proportion due to staphylococci was essentially the same.

These distributions are not intended to indicate with any preciseness the relative proportion of staphylococcus food poisoning to all forms of food poisoning in this military experience. In the first place, the data are by no means inclusive nor complete. A great many outbreaks never came to report and their relative distribution as to type is wholly unknown. Many of the outbreaks of common diarrhea attributed to faulty mess sanitation and other



similar causes may very well have been actual food poisoning. This is aside from those shown epidemiologically to have been transmitted by food and more properly to have been classified as food poisoning. Finally the attendant clinical and epidemiologic circumstances are believed to favor identification of salmonella in comparison with staphylococci. Neither the disease process nor the epidemic are quite so abrupt in onset, nor so short-lived.

#### The Epidemiologic Pattern of Staphylococcus Food Poisoning.

--Outbreaks of demonstrated staphylococcus food poisoning are presented in Table 3. The number of persons at risk was invariably an estimate because actual troop strength at the time of an outbreak was rarely available. The number more commonly represented average strength for the period involved and as such is fairly close to fact and more reliable than most estimates of population at risk in similar civilian situations. The number of soldiers becoming ill includes all who reported to sick call, were sick in quarters, or were sent to hospital. Most were admitted to sick call only.

The epidemic which involved a Quartermaster battalion stationed in southwest England was typical of such instances.

EPIDEMIOLOGIC CASE REPORT NO. 1 - A group of men of the 1512th Quartermaster Battalion messed at irregular intervals from 1330 hours to 2030 hours on 20 October 1943; and for the most part separately, because of the particular nature of their duties. From 2330 hours until 0650 the next morning 29 patients were seen by the medical officer of the organization. They complained of nausea, vomiting, abdominal cramps, and diarrhea. The first symptoms of one patient appeared within fifteen minutes after having eaten, in others after as long as three and one-half hours. Extreme prostration was an outstanding feature. Five patients had hematemesis, in four instances with less than one ounce of blood, but one patient vomited 250 cc. of red blood. Twenty-four patients were discharged within 18 hours, the remainder after 48 hours. Six patients had an elevation of temperature to 99.2°F. or 99.8°F. the day after the episode, but fever lasted for only a few hours. Physical examination of patients when first seen ordinarily revealed severe prostration, subnormal temperature, and diffuse abdominal tenderness. The results of white blood cell and differential blood examinations were within normal limits. Staphylococcus aureus was cultured from four specimens of stools. No other pathogenic organisms were found.

An investigation of the circumstances surrounding this outbreak showed that the mess sergeant had placed a large



container of meat above the stove in order to keep it warm. It was not kept sufficiently hot to inhibit bacterial growth, but rather served as a good bacteriologic incubator. Additional meat was added to the container as the supply became depleted, and without washing the container. The tinned tongue was sliced to size before placing it in the warming receptacle. Bacteriological examination of the corned beef and the tongue which had been served gave a good growth of *Staphylococcus aureus*. Definite confirmation of the origin of this outbreak came from the medical officer of the unit. He ate a piece of tongue about two inches square and a quarter of an inch thick, taken from the same utensil used to serve the affected enlisted men. Within two and one-half hours he became nauseated, vomited and experienced the same clinical course as his patients.

This outbreak was illustrative of classical food poisoning arising from preparation of food too long in advance, with subsequent storage for appreciable periods under conditions which favored growth of food poisoning bacteria and production of their toxic products. Nine of the outbreaks of food poisoning included within this experience were attributed with relative assurance to staphylococci. Sufficiently careful epidemiologic studies were made to indicate a particular article of food. The infectious agent was isolated from the food in all instances, and in addition twice from the feces or vomitus of patients. The clinical reaction was compatible with that of staphylococcus food poisoning.

Many other epidemics of food poisoning were suggestive of staphylococcus origin because of the circumstances surrounding the food that was involved, or more particularly because of the clinical nature of the disease that resulted. They lacked bacteriologic confirmation; and are listed in Column 5 of Table 2.

Most outbreaks occurred under field conditions, where neither opportunity nor time was often available for the careful studies that might otherwise have been made. Laboratory facilities were not always at hand. Furthermore, the study of a staphylococcus epidemic of food poisoning requires initiative and appreciation of the situation on the part of the unit surgeon, because both the disease and the epidemic were ordinarily over by the time an epidemiologist was called. These circumstances account for the relatively large number of epidemics indicative of an intoxication, which were classed as cause unknown or unproven.

Botulism.--Botulism from commercially canned products is extremely rare, but outbreaks are reported consistently among consumers of home-canned foods. Botulism is due to an exotoxin pro-

duced by the growth of *Clostridium botulinum* in suitable medium. Under-processed canned meats, vegetables, and fruits are the most common foods involved. Outbreaks have also originated from preserved foods, such as sausage and smoked meat. The cold pack method of processing foods for home canning is entirely inadequate for the prevention of botulism.

Most foods in which botulinus organisms have grown show evidence of spoilage, characterized by a sharp odor, peculiar acid taste, or the presence of swelling of the container through production of gas. Because of the varying degree of fastidiousness exercised by different individuals in the consumption of spoiled food, evidence of spoilage is not an adequate safeguard against botulism. Furthermore, evidence of spoilage has not been observed in all outbreaks.

Because of the peculiar conditions which govern production of this disease, its occurrence in military practice was even more of a curiosity than in civilian life. Only twice in the history of the European theater was botulism reported among the military population. The first small outbreak in a United States Army camp occurred in England during August of 1944.

EPIDEMIOLOGIC CASE REPORT NO. 2 - Three soldiers warmed a jar of home canned ravioli prepared with meat and tomato sauce, which had been sent to one of the men from his home in the United States. Each man ate a portion. The jar was cracked and the contents smelled sour. A fourth soldier merely tasted the ravioli. Thirty-three hours later, one of the soldiers reported ill with a slight sore throat. He complained of dizziness, blurring of vision, difficulty in breathing, voice changes, and inability to expectorate. Despite inconclusive physical findings, the patient appeared toxic and was sent to hospital. At the time of admission he had a slight muscular weakness of the arms and legs. The pharynx was slightly injected and a marked post-nasal discharge was noted. The patient appeared comfortable during that day. The next morning he awoke, 53 hours after eating the ravioli, with a sore throat and complaint of inability to swallow. Fifteen minutes later he had a generalized convulsion, became cyanotic and lapsed into unconsciousness. Respiration ceased after five minutes. Stomach contents collected at post-mortem examination contained toxin of *B. botulinum* A. One of the remaining two soldiers had eaten approximately as much of the food as the patient who died; the other had taken less, an amount which he described as a spoonful. Fifty-three hours after eating the ravioli, both of these men developed symptoms



botulism. The first soldier complained of diplopia, inability to swallow, and aphonia. The second was less markedly affected, having only slight diplopia and hoarseness. At this time botulinus food poisoning was suspected and about 40,000 unit of antitoxin was given intramuscularly to each man. Physical examination of the first patient showed him to be flushed and apprehensive. He complained of general weakness. The pupils were dilated. There was diplopia with evident weakness of all extrinsic ocular muscles, aphonia, complete inability to swallow, and weakness of the tongue. There was no obvious involvement of the other cranial nerves. The temperature was normal, the pulse slow and respirations unaffected. Both patients improved progressively. One had completely recovered after a few days, while the other still had residual symptoms ten days later. The soldier who had only tasted the ravioli developed no symptoms.

The second of the two recorded outbreaks of botulism occurred in Germany and involved soldiers of a combat unit. The home made delicacies they found did not prove to be as good as they looked.

EPIDEMIOLOGIC CASE REPORT NO. 3 - Three soldiers of A Company, 370th Engineer Combat Battalion gave a history of eating pickles and preserves found in cellars in Goppingen, Germany on 28 April 1945. Other than for these foods, they had long subsisted on K and C rations. All three became acutely ill and were removed to hospital where a diagnosis of botulism was made. Anti-botulism serum was administered. Two patients recovered, and one died of respiratory paralysis some five hours after serum therapy. Autopsy showed death to have been due to the toxin of *Bacillus botulinum*.

Food Poisoning from Salmonella. --The clinical reactions associated with food poisoning by bacteria of the *Salmonella* group showed certain differences from the disease that resulted after ingestion of the enterotoxin of staphylococci. The presumptive identification of certain outbreaks of food poisoning as probably related to the salmonella has depended on the presence of a disease which conformed to that ordinarily resulting from infection with these bacteria. The details are set forth as a means of substantiating the epidemiologic interpretations that were made.

The symptoms of *Salmonella* gastro-intestinal infections were characterized by nausea, vomiting, abdominal pain and diarrhea. The



onset was usually sudden. The attack was commonly ushered in with headache and a chill. Abdominal pain was often the first symptom, was griping and severe, and frequently associated with persistent foul smelling diarrhea. Later in the attack the stools were watery and sometimes of a greenish color. Prostration, muscular weakness, faintness and thirst were marked. There was almost always a rise in temperature, with various nervous manifestations of restlessness, muscular twitchings and drowsiness. Oliguria was often present and herpes frequently followed.

The severity of the disease differed in different outbreaks and among various individuals in the same outbreak. Dosage or number of organisms ingested appeared to be an important factor, since in some experimental work as well as in outbreaks individuals who had a small dose many times escaped without symptoms. All Salmonella organisms causing gastro-intestinal upsets in man seemed to cause identical symptoms, and to be characterized by the same clinical course regardless of the species involved. In a small proportion of cases the organisms invaded the tissues and in this experience were isolated a number of times from the blood. No deaths were recorded among infections reported from the European Theater, although cases occasionally terminate fatally.

One of the most characteristic features of Salmonella gastro-intestinal infections was the time required for symptoms to develop after the ingestion of the food. Also characteristic was the variability in the time within which symptoms appeared. This may have been due in part to varying preponderance of affect from preformed toxin and from actual infection. Short incubation periods were conceivably associated with toxic effect, the longer ones with infection, with intermediate intervals representative of combined action. That a preformed toxin enters into consideration with relative frequency would seem borne out by clinical and epidemiologic observation of the disease, despite the long held contention that salmonella food poisoning is typically an infection. Where symptoms result from infection rather than intoxication, incubation periods may very well vary with the time required for multiplication and invasion by the organisms in individuals with differing degrees of resistance, and subjected to differences in dosage. At any rate, a period of at least seven to eight hours ordinarily elapsed before symptoms developed in the most susceptible individuals, 12 to 24 hours in the majority of cases, and 24 to 30 hours or longer were required in some instances.

Frequency of Epidemics.--Almost as many outbreaks of food poisoning were bacteriologically confirmed as due to salmonella as was true of staphylococcus episodes. (Table 2) The number was 16. On the basis of clinical and epidemiologic criteria an additional 16 were

were considered to be of that nature, compared with 44 unconfirmed outbreaks believed to be staphylococcic. Despite the lesser number of outbreaks in the series, the proportion of confirmed outbreaks was greater; a circumstance attributed to the more favorable conditions for bacteriologic study ordinarily presented by a salmonella outbreak. In addition to food poisoning outbreaks two sizable epidemics among troops of the command came about through transmission of salmonella infection by water. Many sporadic intestinal infections were of this nature.

Through the typing service provided at the First Medical General Laboratory and by the Emergency Public Health Laboratory Service of Great Britain, it was possible to determine the serological types of salmonella involved in food poisoning outbreaks in a goodly number of instances. Type Montevideo was most frequently encountered, four instances. Salmonella aertrycke was determined twice and S. enteritidis, Newport, schottmülleri and suipestifer, each in a single instance. Four strains of Salmonella determined as such were not subjected to further type differentiation.

The Epidemiologic Pattern of Salmonella Food Poisoning.--  
Pertinent information on those instances of food poisoning where some member of the Salmonella group was established bacteriologically as the infectious agent is set forth in Table 4. It will be noted that almost all confirmed epidemics occurred in the United Kingdom, in the proportion of 14 to 2. Salmonella food poisoning, whether definitely determined as such by bacteriological tests or based on epidemiologic evidence, was far less frequently recognized on the continent.

The outbreak of salmonella food poisoning that occurred at the 79th General Hospital in North Ireland, following the supper meal served on 11 April 1944, was classical in its manifestations. Within 24 hours, 267 persons had developed an acute illness marked by intense diarrheal disturbance. The distribution of cases in subsequent days is shown in Figure 1, Table 5. In all, 354 persons were affected; of whom 307 were patients of the hospital, 45 were members of the medical detachment and two were nurses. The clinical disease conformed to recognized descriptions of salmonella infection. The extremes of incubation, dated from the offending meal to the onset of symptoms, were three to sixty-six hours. More than half of the patients became ill within 15 hours or less. The average duration of the acute disease was 3 to 6 days. The initial temperature of patients commonly ranged from 102°F. to 104°F., but a few exceeded 105°F. Diarrhea lasted from 3 to 5 days, but in some instances persisted to a mild degree for as long as a week or more. Almost all of the duty personnel affected had to be admitted to hospital.



EPIDEMIOLOGIC CASE REPORT NO. 4 - The food served at supper on 11 April 1944 was determined as responsible for the outbreak of food poisoning at the 79th General Hospital. Preceding meals could be excluded by the fact that none of 39 patients transferred to another hospital after lunch of that day subsequently became ill. The hospital operated separate messes for officers, enlisted men, and patients. Of the 354 individuals who became ill, 350 had eaten food from the patients mess and three of the other four had contact with food from that mess either in serving or in cleaning dishes. The menus in the three messes had been identical. Analysis of dietary histories directed suspicion to two foods, hamburger steak and rice pudding. Patients on the ulcer ward of the hospital were served no hamburger, and all nine became ill. Some 200 hamburgers left over from this meal were served that night at 2300 hours after reheating. No one eating these hamburgers and having no contact with the patients subsequently became ill. Two nurses who ate hamburgers at that time and became ill were taking care of patients with food poisoning, and presumably could have acquired the infection by contact. The attack rate for 360 persons eating rice pudding was 88 per 100, while for the 82 not eating rice pudding the rate was 21. For 424 persons eating hamburgers the rate was 75 per 100, for the 38 who did not eat hamburgers it was 53 per 100. Analysis of the histories of persons not eating pudding but becoming ill showed contact with that food either by washing dishes that had pudding on them, or in preparing the meals of the ward, or that pudding had been placed on plates but not eaten, or that they had contact with patients with food poisoning during the height of the outbreak. All of the evidence directed attention to the rice pudding as the probable source of the outbreak.

The pudding had been prepared at 0400 hours, April 11. It had been left in flat field range pans at kitchen temperature until served that afternoon at 1600 hours and later.

The cook who prepared the rice pudding gave a history of two to four loose stools daily since 1929. A routine stool culture made a month prior to the outbreak had been negative. After an eight-hour incubation period, he developed a perfectly typical attack of food poisoning. Nevertheless, during the first week of illness (April 17) his serum agglutinated *Salmonella* in dilutions of 1:320.



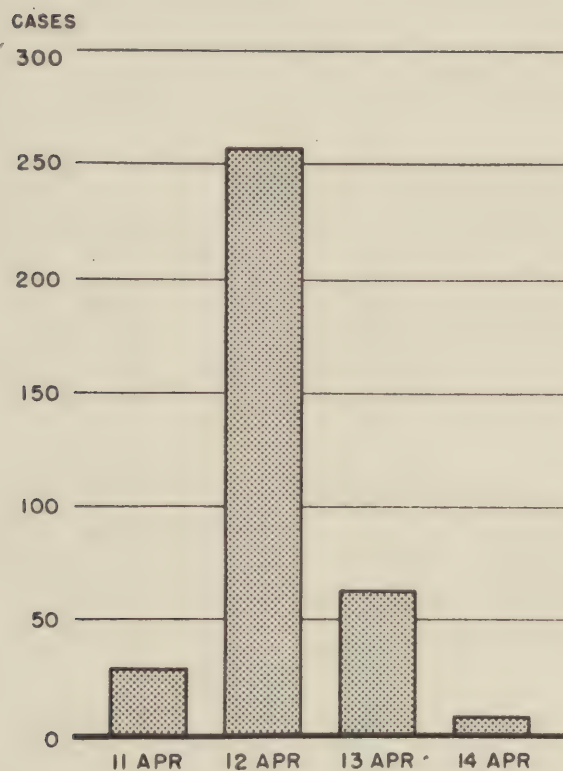


Figure 1

Epidemic of Food Poisoning, Salmonella Montevideo, 79th General Hospital, North Ireland, Distribution of cases by days, April 1944.



Agglutination tests of serums from 24 other patients were negative at that time. All of six stools from the cook, examined between April 14 and May 20, contained *Salmonella* Montevideo.

Samples of food served at the supper meal were not available the next morning. Ingredients entering into the rice pudding were examined, but unfortunately the same lots used in making the offending food were not available. Powdered and evaporated milk, egg powder and bread were found free from pathogenic bacteria.

The stools of more than 100 patients, collected during the acute illness, contained a nonlactose fermenting bacillus which was later identified as *Salmonella* Montevideo. The same bacterium was isolated from the blood of two patients and once from the sputum of a patient with bronchopneumonia. Stool cultures from a series of persons who had not been ill were negative. Of stools from 28 patients examined serially over the next seven weeks, 21 contained *Salmonella* for four weeks or more; but by the end of the seventh week all had become negative.

Only the cook gave a positive serological reaction to antigens of *Salmonella* Montevideo during the first week of the outbreak. In the course of the next three to six weeks, agglutinin titers of blood from patients ranged from 1:50 to 1:800, but decreased after the sixth week. A number of individuals who had remained unaffected during the outbreak showed no agglutinins.

The immediate source of infection was rice pudding, and the causative agent was *Salmonella* Montevideo. The cook who prepared the pudding was believed by medical officers who studied the epidemic to have been a chronic carrier and to have contaminated the food or the pan containing it. Against this interpretation is the fact that the cook developed the disease, an uncommon circumstance for a chronic carrier. Speaking for that assumption is the early and high agglutinin titer that he showed. The cook certainly was a carrier after his illness, but so were many other patients. A stool examination one month previously had been negative. It was considered that contamination of the ingredients, inherent or acquired in the course of storage, would have been eliminated in the process of cooking. It is, however, highly suggestive that the offending *Salmonella* strain was of a particular variety commonly found in egg powder, and that numerous outbreaks of food poisoning have been traced to cooked egg dishes. (See page 15). Powdered egg was used in the preparation of the pudding. At any rate, the practice of preparing such a food long in advance of



serving, and of keeping it warm at room temperature, is certainly associated with danger.

Food poisoning due to the Salmonella almost invariably showed a direct relation to the food, either through infection of the ingredients as in outbreaks associated with egg powder or the overwhelmingly more frequent association with food handlers harboring the infectious agent. Only once in this experience was an intermediate host suggested, although the actual mechanism in that instance may well have been through an infected person.

EPIDEMIOLOGIC CASE REPORT NO. 5 - The 278th Signal Pigeon Company with 141 enlisted men and 9 officers was assigned to the Ninth United States Army. One of the enlisted men developed an acute intestinal infection on 22 October 1944. Within the next two to three days, 50 others were affected, of whom two were sent to hospital. During the next two weeks, at least one or two men of the company became ill daily and five were affected on 1 November 1944.

The illness began suddenly with headache, anorexia, nausea, epigastric cramping pains and severe chills, followed within two hours by five or six profuse, loose, watery stools, containing flecks of blood but no clots. There were extreme tenesmus and urgency. Chills continued during the next several hours, and the fever frequently reached 104°F. Symptoms ordinarily continued in lesser degree for three or four more days. The illness was unassociated with history of respiratory infection or other relevant fact.

Recurrence was not uncommon. No similar outbreak had ever been experienced by this unit, although sporadic diarrhea of various types had occasionally been noted. No defects in sanitation were observed in a careful inspection of the unit mess.

Of the 2160 pigeons housed in the cages of the unit at the time of the outbreak, 159 had clinical paratyphoid infection, evidenced by diarrhea, anorexia, depression and enlarged joints. Laboratory examination of feces from the infected birds served to demonstrate Salmonella typhimurium. The feces of human patients were bacteriologically negative, as were cultures from rectal swabs.

The history and clinical reaction of the men involved in this epidemic are compatible with salmonella infection. Transmission of the infectious agent from infected birds to the food of the mess was a feasible premise, although unconfirmed bacteriologically. The potential danger had long been appreciated, in that no member of the Pigeon Company had been permitted to handle food or serve as kitchen police at posts where the unit was stationed in America. Under field conditions the unit of necessity ran its own mess.

Holiday Food Poisoning.--Repeated experience led to anticipation of a series of reported outbreaks of food poisoning with each approaching holiday season. The festival occasions of Thanksgiving, Christmas, and New Years Day were especially significant. No less than 16 different outbreaks of food poisoning were known to have occurred following Thanksgiving of 1944. (Figure 2) The clinical disease might be suggestive of staphylococcus or salmonella or an unidentified infection, but the attendant circumstances followed a set pattern. These were the times of the year when soldiers expected a really good meal, and to the credit of the Quartermaster Corps, they usually got it. These were the particular occasions when the professional pride of the cook was seriously aroused, when he genuinely tried to meet the challenge expressed in no uncertain terms by the men of his company. The result was that kitchens and equipment were overtaxed. The menus were often so elaborate that food had to be prepared long in advance of serving, and breaches in good messing procedure followed as a natural consequence.

EPIDEMIOLOGIC CASE REPORT NO. 6 - Five hours after Christmas dinner of 1944 was served to the 273rd Company of the 502nd Port Battalion stationed in the Channel Base Section in France, 175 of the total strength of 198 men became acutely ill with nausea, vomiting, and abdominal cramps. Excluding ten men who ate at another company mess and were not ill, the attack rate was almost universal. It was one of the most extensive outbreaks of food poisoning in this experience. Those admitted to hospital or sent to quarters numbered 131. Fever was low grade and recovery took place in from two to eight hours.

Investigation showed that the turkey, which constituted the principal dish, was cooked the night before and carved on 25 December 1944 shortly before serving at 1700 hours. The dressing was prepared by mixing bread, milk, water and seasoning at 0400 hours on 25 December 1944. The mixture was kept on the stove for 12 hours. Giblets were added after soaking in salt water for 18 hours and



the whole cooked prior to serving. Food histories of 97 patients showed that the dressing was the only single item eaten by all those affected.

The unit was housed under canvas and the kitchen was in a walled tent. The general sanitary situation was particularly good, except for lack of immediate hand-washing facilities. The fault would appear to be one of mess management through too early preparation of the dressing for the turkey without proper protection against contamination. The clinical nature of the disease suggested staphylococcus food poisoning, although bacteriological confirmation was lacking.

EPIDEMIOLOGIC CASE REPORT NO. 7 - Thanksgiving dinner was served to the enlisted men of various companies of the 58th Armored Infantry Battalion of the 8th Armored Division at 1500 hours, 24 November 1944, at a common mess hall in Tidworth Barracks, Southern England. The meal consisted of roast turkey with dressing, salad, potatoes, peas, dessert, and coffee. The whole meal was eaten by most of the men, except for dessert in some instances and salad in others. Turkey and dressing were the common foods taken by all who became ill. Because of inadequate facilities at the unit mess, the turkey and dressing had been prepared and cooked by a Bakery Unit of a neighboring British Quartermaster organization about fifteen to eighteen hours before serving. During the 24-hour period ending 2100 hours, 26 November 1944, 77 enlisted men were admitted to hospital with acute gastroenteritis. Almost all had fever of 100°F. or more and some as much as 103°F. The common complaint was of abdominal cramps, frequent watery stools, and occasionally of prostration. The early symptoms were headache, chills and fever, followed by nausea, vomiting and diarrhea. The average time of onset was about 24 hours after the offending meal. Salmonella were isolated repeatedly from the stools of patients sent to hospital. The total attack rate remained unknown but it was greatly in excess of the number admitted to hospital.

EPIDEMIOLOGIC CASE REPORT NO. 8 - About 45 of the men of the 3111th Signal Service Battalion with Advance Section, Communications Zone, in France became ill with acute gastroenteritis after partaking of New Years Day dinner, 1 January 1945, at the unit mess. Some 100 men were absent from dinner but did have breakfast and supper at the mess. None





Figure 2

Thanksgiving Turkey served to combat men, Continental Europe, November 1944.



were ill. The attack rate for those dining at the unit mess was about 13 per hundred. The onset varied from 2 to 8 hours after eating the meal and was ordinarily sudden, with sharp intermittent abdominal cramps, moderate watery diarrhea, and considerable prostration and dehydration. Recovery was relatively rapid. Turkey and potato were the two foods common to all patients. The turkey was received in the frozen state two days before serving. It was thawed by soaking in water and roasted approximately 20 hours before serving. The roasted birds had been stored in a cool place until the morning of 1 January when they were carved, the meat placed in pans, and reheated in field ranges one to two hours before serving. The vegetables including the potato, were prepared at this time. The roasted turkey appeared to be definitely the cause of the difficulty, and the condition was evidently ~~staphylococcus~~ food poisoning.

Food Poisoning from Powdered Egg --Fresh shell eggs neither locally procured or imported from the United States were almost a curiosity in the messes of the United States Army in the ETO during the war. The egg used in custards, cakes, ice cream and a variety of other foods came almost wholly from powdered spray-dried eggs. Scrambled eggs and omelets likewise originated from powdered egg. Only on rare occasions were fresh fried eggs included in the menus of even the most exclusive messes.

Although powdered egg had been produced in America for a number of years, the industry was essentially a war-time development. Prior to the war, no well established standards had existed in regard to production requirements, moisture and bacterial content of the finished product, or methods of packaging. These standards had to be developed during the expansion of the industry and under the pressure of meeting military requirements.

Powdered egg was also used extensively by the British civilian population. The source of supply was from the same American producers who prepared powdered egg for the United States Army. The product was imported into Great Britain on a small scale towards the end of 1941. From then until July 1942, distribution was restricted to bulk supplies furnished bakers, confectioners, and caterers. In July 1942, the first issue of five ounce packages was made through retailers to the general public.

The frequency of salmonella infection among poultry of the United States, and the ineffectiveness of the drying process in insuring destruction of even nonsporing pathogenic bacteria in the



egg, suggested to British health authorities that it would not be surprising if bacteria belonging to the Salmonella group were found in the final product. The correctness of this surmise was verified in August of 1942 when examination of 43 samples of egg powder showed five to contain viable Salmonella. Between August 1942 and May 1943 a total of 2,085 samples of egg powder were examined in British laboratories. Of these, 121 or 5.8% were found to be infected with organisms of the Salmonella group. The type distribution is presented in Table 6.

Food poisoning from duck eggs infected with Salmonella bacilli had been reported a number of years before. The experience of the war brought out the relative frequency with which eggs of the hen were also a source of the salmonella form of food poisoning. The problem was thoroughly investigated by the British Ministry of Health, and by health authorities in the Zone of the Interior.

In no instance was a bacterial count recorded of over 30 Salmonella bacteria per gram of egg powder, showing that the degree of contamination was relatively light. Of a total of some 1865 samples of powdered egg examined by the laboratories of the British Ministry of Foods and of the Emergency Public Health Laboratory Service, 0.2% of samples contained staphylococcus aureus and 7.6% contained some one of the Salmonella group. Included among the Salmonella were five types never known to have been involved in human infections. Of the types of Salmonella known to produce food poisoning of man, the commonest isolated from commercial samples of egg powder were Bacterium Orienienburg, Montevideo and Bareilly. (Table 6)

Evidence Relating Dried Egg to Food Poisoning.---All types of Salmonella isolated from dried egg powder were known to be potentially pathogenic for man. Some indication of the frequency of food poisoning due to dried egg was obtained by studying the distribution of Salmonella types in cases of food poisoning in the United Kingdom before and after the introduction of that product.

For many years before the war the Ministry of Health Laboratory of London had been the center for bacteriologic investigation of food poisoning outbreaks. In this way knowledge of the types of Salmonella responsible for the major outbreaks of food poisoning in that country was collected in a single laboratory and published annually by the Ministry of Health. The data are contained in Table 7.

There are several points of interest in the table. It will be noticed that during the seventeen years 1923-1939, only fourteen different types of Salmonella were identified as being responsible for food poisoning in Great Britain. Never were more than nine types isolated in any one year. All strains were examples of well-known European Salmonella types, such as Newport, Derby, Eastbourne, Stanley, London and Aberdeen. Examination of the figures of 1940 and 1941 shows the type distribution to have been similar to that of pre-war years. In 1942, a change occurred. The usual types were represented but in addition seven new types made their appearance as shown in the lower half of the table. In all, no fewer than 15 different types were recognized in 1942, nearly twice as many as in any single pre-war year. A study of the new types showed that four, namely Orienienburg, Montevideo, Bareilly and anatis represent the commonest types found in spray dried eggs. (Table 6)

The distribution of dried egg to the general British public began in July 1942. Of the nineteen strains of the seven new types of Salmonella encountered in cases of food poisoning in 1942, fifteen were isolated in the second half of the year. The possible connection was strongly suggestive. It is true that two strains of Bacterium Montevideo had been isolated in July and September of 1941, and one of Bacterium Oslo in March 1942; but this also was after the distribution of dried egg to wholesalers had begun. Of the ten new types observed in 1941 to 1943, only two--Bacterium Reading and Bacterium Chester--had ever been met within Great Britain before; and these were responsible for only three cases of food poisoning.

The possibility that some other food such as pork was the vehicle of these new types was seemingly eliminated by the fact that the common type associated with pork, Bacterium cholerae suis, showed little evidence of serious increase in 1942 or 1943.

It is possible that the new types were introduced by American and Canadian troops, since the Americans began to arrive in appreciable numbers only towards the middle of 1942. The two principal objections to that hypothesis were that most of the food poisoning due to the new types appeared to have been among civilians, and secondly that the new types nearly all corresponded to those found in fowls, or in dried eggs, rather than to those so far found in human beings in North America.

Prevalence of Food Poisoning from Powdered Egg among British Civilians.--Not only was the number of individual types of Salmonella greater but more cases of food poisoning occurred compared with pre-war years. During the period from mid-May 1943 until



5 September 1943 seventy-eight persons contracted food poisoning traceable to powdered egg, of whom seventy-two lived in seven administrative districts of Great Britain. The largest outbreak involved 26 persons at a hotel. The rest were made up of small family outbreaks. All other foods and cooking substances could be eliminated in these outbreaks except powdered dried egg.

Food Poisoning from Powdered Egg in the United States Army.

--The Oxford Laboratory of the Emergency Public Health Laboratory Service, Great Britain, was responsible for identification of Salmonella strains and the investigation of food poisoning outbreaks for the Ministry of Health. The relations of the United States Army forces with this installation were always close. As a consequence, pathologic materials from patients with food poisoning in hospitals of the United States Army of the neighborhood were invariably examined there. Strains from more remote sections of the theater were also sent for identification. The data included in Table 8 are by courtesy of that laboratory. The examinations recorded are for the first nine months of 1943. No specimens were submitted from cases of food poisoning among United States personnel between June 1942 and December 1942.

Most of the cases of Table 8 represented sporadic infections. The predominance of types of Salmonella commonly contained in powdered egg is readily apparent, particularly Salmonella Orienienburg and Salmonella Montevideo.

Since dried egg was so universally a part of the diet of American soldiers it was difficult to incriminate it in any given case of food poisoning. The following instances were suggestive:

EPIDEMIOLOGIC CASE REPORT NO. 9 - C.S.R. was a United States Army cook. He awoke at 2 a.m. with abdominal cramps, nausea, vomiting and diarrhea. During the next 24 hours he had eleven bowel movements, but these subsequently dropped to three to five a day, over the next eight days. Bacterium Orienienburg was isolated from the feces on more than one occasion and the serum agglutinated Bacterium Orienienburg H, 1:800. No particular food was suspected and there were no other cases in the unit. The patient however, gave a history of drinking daily a milk shake made with uncooked egg powder.

EPIDEMIOLOGIC CASE REPORT NO. 10 - Private J. M. was admitted to hospital with a history of diarrhea and vomiting of three days duration. He appeared to be suffering



from a simple gastro-enteritis of the food poisoning type. Bacterium Orienienburg was isolated from his feces and his serum agglutinated Bacterium Orienienburg in 1:320 dilution. Inquiry revealed that his diet had consisted mainly of canned meat and egg dishes made from dried egg. Since there is no record of the isolation of Bacterium Orienienburg from domestic animals in the United States it is improbable that infection was derived from the canned meat.

EPIDEMIOLOGIC CASE REPORT NO. 11 - Thirteen men of the 535th Quartermaster Service Battalion developed an acute gastro-intestinal upset on 1 November 1943. Food histories gave evidence that only those men who had eaten eggs at the breakfast meal became ill. A sample of the egg powder used in preparation of the scrambled egg was submitted for laboratory examination and reported free from dysentery and other micro-organisms. Stool examinations of the patients were likewise negative. On epidemiological grounds this would suggest a small outbreak attributable to powdered egg.

In no instance in this appreciable series of recorded outbreaks of food poisoning was it possible to identify the same member of the salmonella group in a suspected batch of egg powder and in the stools or other materials from patients. This rigorous requirement is not altogether justified by the circumstances.

Clinical food poisoning after ingestion of powdered egg was of two types. One form was evidently due to a particular toxin present in the powder, in that symptoms developed less than 8 hours after eating and usually within 2 to 3 hours. All of the 79 cases reported for the Ministry of Health were of this nature. In four instances samples of the particular egg powder that was eaten were proved bacteriologically to have contained Salmonella. However, in no instance was Salmonella of the type found in the egg powder that had been eaten, or of any other type, ever isolated from feces or vomit although examinations were made in at least 21 cases; not always under the most favorable circumstances in respect to time. The second form of food poisoning from egg corresponds to salmonella infection, with an incubation period of at least 8 hours and usually 18 hours. The nature of the toxin contained in certain samples of dried eggs remained unknown, but that it exists has been proved by several experiments on human volunteers. No reliable test animal was found. The evidence would indicate that poisoning by toxin was by far the more common. Salmonella infections would expectedly be obviated by the method of preparation--adequate cooking of the egg powder.

The possible relationship of egg powder was suggested in a number of other outbreaks and in some of the major ones. Particular attention was repeatedly directed to the frequency with which rice pudding was involved, a food commonly prepared with egg powder in army practice. Of the total number of outbreaks of food poisoning included in this series twelve were attributable to rice pudding. An outbreak related to bread pudding and a number of others suggested an origin resident in egg powder. Actual confirmation was lacking. There is no doubt that a number of sporadic cases of food poisoning among American soldiers were due to this cause or at least to micro-organisms commonly demonstrated to be present in egg powder.

The evidence contributed by British laboratory and epidemiological workers, and the experience of the United States Army leads to the belief that egg powder was a far more pertinent factor in food poisoning than would be indicated by the actual record of confirmed outbreaks. The difficulties related to powdered egg presumably could arise from unsatisfactory processing, from an undue proportion of badly infected birds in certain regions, or from contamination of the materials in the course of packaging. Much progress was made in the Zone of the Interior in developing standards for egg powder and in accomplishing improved methods of production. Food poisoning due to egg, both from toxin and infection, would appear to be preventable. The problem has sufficient significance to warrant continued study.

Prevention of Food Poisoning and Food-borne Infection.--  
Irrespective of whether an intestinal disorder is related to food poisoning or arises through food-borne infection of a specific infectious agent, preventive measures are based on the same general principles. Preventive programs are rarely directed against any single intestinal disease. Even when the difficulty is an epidemic of an individual member of the group, such as bacillary dysentery, the measures instituted are general in nature; for the conditions predisposing to widespread prevalence of any one of the group commonly lead to increased incidence of several of the intestinal infections. A persisting high rate for intestinal diseases in a military or civilian population is commonly the cumulative effect of more than one. The situation in the field armies of the European Theater in the autumn of 1944 is in point.

Furthermore, the measures to be applied either in prevention of the disease, or in the control of epidemics, are necessarily general in nature and directed toward improvement of the environment. No specific preventive measure exists for food poisoning; they exist only for the typhoid-paratyphoid group of the food-borne infections. Even with the latter diseases, control of the environment is the principle reliance.



The contamination of food which led to episodes of intestinal infection took place in a variety of ways and at various stages in the process of preparing and serving the finished foods. In rare instances, the fault was in the ingredients from which the food was prepared. Contamination occasionally occurred in the course of storage of the food components. Much more commonly it came in the course of preparation, either from extraneous sources, from dirty utensils, or most common of all from the fecal discharges of the cook or his helpers. Contamination that entered in the course of serving was a lesser consideration, because of the lack of time for multiplication of bacteria, the resultant low dosage, and consequent ingestion in nearly innocuous amounts. Since people were primarily involved in the genesis of food poisoning or of food-borne disease, either through their own carelessness in personal habits, or through lack of information on the sources of food infection, it followed that the first requisite in a program of prevention was education. Educational measures designed to limit transmission of intestinal infection by food were directed toward two groups of individuals. The general military public was the main consideration--the soldier of the army. A second and limited special group included food handlers, cooks and their assistants.

Educational Program.--The general educational program for the soldier depended principally on unit training. Methods for limiting intestinal infections formed a part of instruction in general health measures. Details of the lectures and discussion hours are beyond the province of this discussion. In addition to this personalized instruction, emphasis was placed on local poster campaigns; various moving pictures were used; and other methods of visual education employed.

From time to time, unusual conditions made desirable a theaterwide approach directly to the soldier. Illustrative of such a circumstance was the impending departure of troops to a life in the field after the long period of training in the island base of Britain. Special discussion hours--briefing in the parlance of this war--were devoted to familiarizing the soldier with the new conditions that he would encounter in a world he knew little of, on continental Europe. All didactic and routine considerations were discarded. This was a straightforward talk about the specific situation to be met. It was assumed that the soldier knew the principles of good field hygiene. He was told of night soil fertilization of fields, of the ubiquitous honey bucket of France, of the vindangeur, and of roadside, curbside and doorstep freedom of the population in meeting the calls of nature. He was ac-



quainted with the risks these practices brought to the use of fresh fruits and vegetables, to an extent wholly foreign to most American soldiers.

When the line stabilized in northern France and on the German border in late 1944, a life in foxholes became the existence of the moment. A series of articles was published in the army newspaper, Stars and Stripes, on the general theme of how to keep house in a foxhole. An appropriate division of space was devoted to advice on how to run the foxhole kitchen; in other words, how the soldier could protect himself from food-borne infection under a most difficult kind of life. Discussion groups under the auspices of the publication known as Army Talks used the same material.

The special instruction of food handlers fell to the responsibility of unit mess officers and unit mess sergeants. It was individual and intimate instruction, the most practical approach. This effort was reinforced by more formal training in schools for cooks and bakers, conducted by the Quartermaster Corps at the American School Center, and participated in by members of the Preventive Medicine staff. One nutrition officer was assigned to full time duty at the school, both while it was in England and later in France.

Another training procedure for food handlers came through the agency of traveling teams from the Subsistence Division of the Quartermaster Corps and the Nutrition Branch of the Preventive Medicine Division. No little part of the daily work of nutrition officers in the field was likewise devoted to mess management, with advice and instruction given on a personal basis to mess officers and mess personnel.

Direct educational measures in messes made use of signs and posters which dealt with food waste, the inherent dangers of leftovers, the need for handwashing, and other matters of personal hygiene on the part of food handlers.

Unit medical officers were reached primarily through the circular letters of the Office of the Chief Surgeon. The technical medical bulletins of the War Department furnished more general types of information. Other professional information was published from time to time in the Medical Bulletin of the Office of the Chief Surgeon, including such subjects as the occurrence of the diarrheal diseases in the European Theater, and the methods that were available for the laboratory diagnosis of the intestinal diseases. One leading article was contributed by the Chief Surgeon himself, when he wrote on "Let's Stop Scrubbing." He brought out the advantage

of getting a kitchen really clean, and then trying to prepare a meal with an honest effort to avoid making any dirt.

Cleanliness of Messes and Kitchen Equipment.—The great number of persons in a military organization responsible for the inspection of messes inevitably led to a situation where many officers and non-commissioned officers of limited experience had of necessity to be entrusted with these duties. There was consequently a need for carefully thought out instructions if they were to bring out the more important considerations.

A particularly good order on the subject was issued by one of the base sections of the Communications Zone. It dealt with the protection of foods, the inspection of messes, the precautions to be observed in the preparation of food, and the washing of mess kits and utensils. The cogent directions in respect to general cleanliness and order of kitchens included prohibition of common drinking cups, the observance of orderliness in the placing and hanging of utensils and direction that tables, benches, and blocks were to be scrubbed with hot, soapy water after each meal. Soiled rags were not to be left on work surfaces; ovens and stoves had to be thoroughly cleaned, and flies and other insects eliminated by all means available. Mops were to be cleaned by immersion in boiling, soapy water and neatly arranged, suspended with mopheads down and away from walls and furniture. Kitchen and mess hall floors had to be washed daily, avoiding excessive amounts of water. In the event that the kitchen and mess floors were earthen or gravel, extreme caution was to be exercised in avoiding spillage. If that occurred, three percent borax solution was directed to be sprinkled on the ground to aid in the prevention of fly breeding. In any event, floors were to be raked daily or more often if necessary.

Mess advisers of the Quartermaster Corps and the Nutrition officers of Preventive Medicine did much to establish the principle that an inspection must needs be constructive and educational, as well as supervisory and administrative. All sorts of little affairs contributed to the disorder of messes and the potentiality of food infection--the practice of stacking benches on mess tables during scrubbing, failure to keep the surfaces of meat and vegetable cutting tables planed smooth, and the use of battered wooden paddles which collected food and dirt. The location of garbage cans and waste baskets often determined the extent to which they are used. People with dirty and wet shoes were not permitted in kitchens. Doughs should be mixed on the center of tables, instead of at the edges. Pots and pans with dirty bottoms were not to be put on clean stoves, and tables and garbage cans were to be immediately at hand when potatoes were peeled or peas shelled.



All of these matters involved the prevention of dirt and disorder, to the end of maintaining clean kitchens and avoiding the final grand clean up. The stress placed on the individual soldier to keep his mess gear clean was not always accompanied by the same degree of attention to kitchen utensils, pots and pans and other equipment of the kitchen itself. They many times suffered poorly in comparison.

To prove that a dirty mess of itself was the direct cause of an outbreak of food poisoning was never possible, but at least there was no surprise when trouble occurred in instances such as the following:

EPIDEMIOLOGIC CASE REPORT NO. 12 - An outbreak of food poisoning involved about 50 men of Depot E-508P, 24 November 1944. Inspection of the mess subsequent to this episode showed the ice cream freezer to be a health hazard since it was so full of cracks and rough seams that it was impossible to clean it properly. Due to lack of hot water, kitchen utensils, knives, forks, spoons and dishes were not being properly washed and sterilized. Compound germicidal rinse had never been used. Dishes were air dried but greasy. Knives, forks and spoons were greasy and were being wiped with unclean towels. Sinks were dirty and utensils were greasy.

*Staphylococcus aureus* was isolated in moderate numbers from the turkey which was the principal dish of the meal. *Bacillus aerogenes* was found in moderate numbers in the dressing, and the gravy contained *Staphylococcus citreus*. No organisms were isolated from the tea. Condiments contained small numbers of *Staphylococcus albus* and the milk mixture for the ice cream contained a moderate number of *Staphylococcus aureus*. There was every indication then of contamination of several elements entering into the food. The general state of the mess readily suggested how that could have come about.

The first emphasis in mess management was thus on cleanliness, and its accomplishment was sought through education and through intelligent inspection. Some basis might exist for the belief that the severe ritual of cleanliness in kitchens was overdone in military practice---that the effort expended was out of proportion to the relative danger from environmental dirt---were it not for the knowledge that the general state of cleanliness of a mess was about the surest index to the level of mess practice. (Figure 3) If floors and stoves were in a slovenly state, the people in the kitchen were also likely to be so. And it is granted that people are responsible for most food-borne infection.





Figure 3

Transient Mess, Lerouville, France, June 1945.



Limitation of Flies and Other Insects.--The activities of flies and other insects in the spread of intestinal infections are almost wholly concerned with the contamination of food. It was nevertheless impossible to single out any given situation where with surety it could be concluded that an outbreak of food poisoning or food-borne infection was directly traceable to flies. Other existing circumstances usually suggested an equal importance; for like general untidiness, an otherwise circumspect mess rarely had the single fault of a fly menace. It was by no means impossible, however, to determine situations where flies were in all likelihood a major consideration.

EPIDEMIOLOGIC CASE REPORT NO. 13 - An outbreak of 26 cases of food poisoning occurred in Bishops Cleve Camp in the United Kingdom, 14 July 1942. Many flies were found in and near the kitchen. There was an inadequate mess kit laundry. Latrines were not flyproof, and pollution of the ground surrounding the kitchen area with human excreta was by no means uncommon. A manure pit near the kitchen showed the presence of many fly larvae.

A bizarre source of difficulty in respect to insects was encountered in the early days of the Normandy campaign. Field messes were almost universally plagued by an outspoken infestation of bumble bees. The control of these insects gave entomologists more trouble than the fly problem.

Considering the situation as a whole, the prevalence of flies in Great Britain was never great, although local problems were not absent. Flies were more of a concern on the continent, but no more than would hold true for most parts of the United States during the summer months. It was not believed that fly-borne transmission entered very pertinently into the frequency of intestinal infections. The control of flies formed a part of the program for prevention, but not a major consideration.

Inspection of Foodstuffs.--Inspection and certification of all products entering into the preparation of foods was found to be an important part of a preventive program. This service was provided by officers of the Veterinary Corps for foods of animal origin, and in addition they took an important part in the inspection of food stuffs in general.

Actual existing contamination or infection of food ingredients as delivered to unit messes was an unimportant consideration among causes of food poisoning. Much of the basic food received at army messes came in cans. The modern development of the American food packing industry, and the rigorous control which took place at the source, eliminated any appreciable danger from canned foods.



Theater regulations required all personnel employed in receiving or issuing canned goods in storage, particularly meat, meat foods and dairy products, to be instructed as to what constitutes a sound can. Badly dented cans and those with any odor were to be put aside for ultimate inspection by a veterinary officer. Warehousing personnel were instructed to make careful daily examinations for the presence of foreign odors or mustiness in the storage rooms. This was done before work began, and while doors and windows remained closed. It was recognized that complete inspection of canned goods was impractical and reliance was placed on frequent spot checks.

A number of outbreaks of food poisoning were recorded in which suspicion was directed to a presumably improperly sterilized can of food as the source of infection, but the evidence was always such that contamination after opening the can could not be eliminated. Other cans of the same lot were often shown by laboratory examination to be innocuous. Only an occasional outbreak in this recorded experience could be considered with any assurance to have arisen from contaminated food ingredients. The instance cited below is suggestive, but the evident faults in mess management may have been more than contributory.

EPIDEMIOLOGIC CASE REPORT NO. 14 - Food poisoning at the Camp Malpas port of embarkation camp on 19 March 1944, involved about 80 men of three companies who ate at a single mess. Food histories incriminated chicken, served principally at the noon meal and to a few men at the evening meal. The chicken had arrived at the camp in the frozen state on 17 March 1944. Some of the meat appeared spoiled, and a veterinarian who was called condemned a number of chickens. The remainder were thawed in water on 18 March, and the entrails removed. The meat was boiled for two hours in the evening, removed from the carcasses largely by hand, and set aside in roasting pans in the meat room. The following morning a hot cream sauce was added, and the chicken warmed for the noon meal. Some of the creamed chicken that remained was kept on the stove and served for supper. However, the officer on duty ordered it thrown away before many men were served, as it did not appear right.

Other than occasional similar instances related to poultry, the difficulties ascribed to infected ingredients were largely limited to powdered egg containing Salmonella bacteria or their toxins, the detection of which was beyond the limitations of field inspection of food materials. Outbreaks due to this cause have been described in a previous section.

Fresh vegetables and fruits gave little concern. No great amounts were used because of the theater policy of importing from

America the great bulk of food required by the United States Army. Local purchases were essentially limited to potatoes and root vegetables. Food prepared from cereals were a common source of food poisoning outbreaks, but the difficulty was in their preparation, not in an innate fault of the materials themselves. All of milk used in the army was either canned or in powdered form; and what danger existed from this source was related to its reconstitution and subsequent storage.

Protection of Stored Basic Foods. --The American forces in the European Theater encountered conditions which were foreign to the experience of most, in that there was relatively little provision of refrigeration, even to fixed units of the Services of Supply and of the Air Forces. Essentially none was available to Ground Force units. This required more than usual attention to proper methods of storage. Construction specifications provided for screening of food storage rooms, kitchens, and mess halls, but the requirement was by no means universally met. Food storage rooms were required to be kept scrupulously clean, with stores arranged in a neat and orderly manner. Food was to be stored in a cool, dry place. In the absence of refrigeration, repeated attention had to be given to the all too common practice of storing foods in places that were too hot, in the corners of kitchens and in heated buildings. There was too often the attitude of no refrigeration, then put it anywhere; instead of a genuine effort to get the coolest possible storage.

Flour, sugar, bread, and similar items were required to be kept covered. Bread boxes were directed to be constructed, using mosquito netting to afford proper ventilation. Special instructions had to be issued in respect to the transport of bread, because of particularly bad practices that had become altogether too general. It was required to be protected from the sides and floors of dirty trucks by the use of boxes and cartons. Frozen meats, which were the common source of supply, were left in the original containers, stacked closely together so as to aid in preservation until used. The general recommendation was made that frozen, ground meat was to be used before other meat, even if it involved changes in menus. Greater frequency of meat issue was advised when local conditions made meat storage difficult or unsound. All packages, boxes, and bags were stored at least one foot off the floor. Vegetables were stored in bins that permitted proper ventilation, and were sorted daily to remove rotten or spoiled materials. All perishable items were directed to be rotated in order to insure proper utilization of food stuffs. The continued and stringent attention given to the storage of basic foods in military practice would suggest that contamination after receipt at the unit storeroom in good order, was a common and likely source of food poisoning. And yet this large



experience does not contain a single instance in which an epidemic was ascribed to spoilage during storage. Perhaps it was because of the outstanding attention given this feature of food protection that so little difficulty was encountered.

Improper Mess Management.--An analysis of some hundreds of food poisoning epidemics of varying size, and the observations arising from practical experience in the field, gave evidence that the most frequent source of danger of food poisoning epidemics was in the course of preparation of food.

Contaminating bacteria may enter food in so many ways that only general principles can be cited. Food may become a potential source of infection whenever dirt enters it. The first requisite therefor is to keep a clean kitchen. The emphasis placed on that consideration in military practice is common knowledge, and it is thoroughly justified. Nevertheless it was most unusual in the course of an investigation to find agreement or acknowledgment among mess personnel that a dirty kitchen was ever the cause of a given outbreak. The tendency was always to attribute the difficulty to some defective food, or to the water supply, or to any condition lying outside the kitchen. But most causes of food poisoning were within kitchens.

The basic training of cooks and bakers was of such quality that little necessity existed for stressing the need of thorough cooking of meats, custards, puddings and filled pastries. If there was a tendency in army cooking, it was to overcook rather than undercook. Three kinds of bad practice were, however, altogether too common. They required continued effort in correction and prevention. They were responsible for a large proportion of the outbreaks of food poisoning among the command.

Too Early Preparation.--The first to be mentioned was the preparation of food too far in advance of the meal at which it was to be served. To a degree, this was unavoidable. The preparation of food for large bodies of men who had to be fed within a limited period was a matter of no easy accomplishment, especially with the limited facilities that were too often available in army kitchens. The direct result was that hours were spent in the preparation of a given meal and that certain items, of necessity or by reason of the cook's convenience, were prepared long hours in advance. The important consideration was the proper choice of the foods to be prepared in advance. Some articles of food conform to such preparation; others do not without introduction of unwarranted hazards. Altogether too common a practice, which of course obviated reheating, was to prepare foods far in advance of serving and to set them aside in pots or warming pans on the back of the stove where they remained neither hot nor cold, but to all practical purposes maintained the temperature of a good bacteriological incubator. (Figure 4)





Figure 4

Kitchen stoves as Storage Places for Cooked Food, 155th General Hospital, England, 1944.



EPIDEMIOLOGIC CASE REPORT NO. 15 - A small group of men of the 825th Convalescent Center, 17 in all, developed an acute intestinal illness as a result of eating hot dogs at the unit night mess, 25 February 1945. The frankfurters arrived at the mess hall in the frozen state, early Saturday morning 24 February 1945. They were put on the kitchen table and allowed to thaw in the course of the next four hours. They presented no unusual odor or appearance. They were steamed between 1000 and 1100 hours and served at the noon meal. Those left over were reheated at 1700 hours and served for supper. About 40 or 50 frankfurters still remained. They were left standing in the pan on the back of the stove and reserved at the midnight mess, being dispensed from the pan on the stove where they had remained warm since 1700 hours. Only those eating frankfurters at the midnight mess became ill.

Given sufficient time, the bacteria contained in foods so treated had ample opportunity to multiply. Large doses of organisms were produced, capable of setting up an infection of the human host, or of providing sufficient toxins to produce violent symptoms shortly after ingestion of the food.

Long Storage at Room Temperature. - A similar practice, but associated with greater danger because of the type of food to which it was ordinarily related, was the early preparation of desserts and their subsequent storage at room temperature for long periods. A corner of the kitchen was commonly selected, with no attention given to preliminary cooling. The result was that the food remained warm for considerable periods, depending on the room temperature and the size of the container. Lack of proper covering and protection from flies and other insects sometimes contributed to the danger. The long holding on the stove in course of preparation was usually no more than carelessness. The latter practice was so palpably dangerous as to present little excuse.

EPIDEMIOLOGIC CASE REPORT NO. 16 - An outbreak of food poisoning at the 96th General Hospital in Great Britain involved 652 patients and some few attendants among a hospital population of 976. Food histories served to incriminate pumpkin cobbler as the food concerned. It was served at two meals and only those who ate this food at one or the other meal were ill. The food was served only in the patients mess and only those who ate there were affected. The cobbler was prepared between 1800 and 2400 hours on 5 November 1944, and stored in the pantry at room temperature until served either 12 or 18 hours later.



Because of the frequency of such episodes as that described, measures were taken to require special care in the preparation of dishes such as creamed foods, hashes, reconstituted powdered eggs and milk, custards, puddings, and desserts with creamed fillings. These foods were directed to be prepared as close to the time of serving as possible and in quantities no greater than could be used at one time. Egg powder and reconstituted dried milk were to be prepared no more than one hour before use. Meats including poultry were not to be thawed in water, near hot stoves, nor in the sun, but allowed to thaw by natural process in a cool place. The thawing of poultry in water was appreciated as being a particularly pernicious procedure. The meat was not to be cooked at night for use the following day. With the exception of the canned corned-beef hash which was a substitutive part of the ration, hash was not to be served as food unless freshly prepared.

Leftover Foods.--Food conservation was a matter of military importance, since all food had to be brought long distances by sea. As a result shipping allotments came to have a strong influence on mess management, because food that could be saved affected the required theater allotment of tonnage. A strong emphasis was placed by command on avoidance of waste. (Figure 5) Inspectors gave this matter much attention and the penalties imposed for infractions of regulations were decidedly severe. Food conservation received more emphasis in the Services of Supply than in other major commands, to the extent that it was sometimes overdone. This had a direct affect on the rates for food poisoning which were greater in the Services of Supply than in other branches of the service.

EPIDEMIOLOGIC CASE REPORT NO. 17 - Fresh creamed peas were served at the evening meal on 21 July 1943 to the mess of Headquarters Company, A Company and the Officers' mess of the 850th Engineer Aviation Battalion. Half of the creamed peas were consumed at the evening meal. The remainder was put in one large and one small aluminum container and stored at room temperature at the end of the mess hall. About 18 hours later both containers were reheated for the noon meal of 21 July. The small container was placed on the mess line and served to the enlisted men. The officers mess used peas from the large container, which was then delivered to the mess line. There a cook noticed that the peas "smelled sharp" and they were discarded. Thirty-five officers and eight enlisted men were treated for gastro-enteritis in addition to an unknown number too mildly ill to require medical treatment. The large container obviously cooled more slowly and maintained a more



Figure 5

Food Conservation, Oise Section, Communication Zone, June 1945.





favorable incubation temperature for bacterial growth over a longer period. Peas from the smaller container gave rise to no food poisoning.

By choice, leftover foods should be conspicuous by their absence. Effort was made to keep them at a minimum, through careful estimate of the amount of food required for each meal. If leftovers did occur, they were to be stored in shallow containers in a cool place, kept covered, and thoroughly reheated just prior to serving, which should be no later than the next meal. It was stressed that reserving of overnight leftovers was extremely hazardous. The possibility was emphasized of limiting the amount of leftovers through careful estimate of the amounts of food required for a given meal. Palatability was stressed as a means of holding leftovers to a minimum. With the most careful practices, however, difficulties still occurred. It was one of the difficult problems of mess management.

Treatment of Raw Fruits and Vegetables --The management of raw fruits and vegetables was a minor concern for troops stationed in Great Britain, because of the scarcity of supplies and the relative infrequency with which such food materials were purchased on the open market. Moreover, the conditions under which fruits and vegetables were produced were such that no more danger was involved than in American practice. Conditions were otherwise when the troops went to the continent, because of the common practice of using human feces in the cultivation of fruits and vegetables. In the early days of the campaign a strict prohibition was placed on the purchase of these items. A later regulation provided that fresh fruits and vegetables could be eaten if first carefully cleaned mechanically and then either cooked or, if eaten raw, were first treated with mikroklene, compound germicidal rinse. This involved thorough washing and trimming of all portions of the food, and the removal of soiled and damaged parts. Leafy vegetables were separated into individual leaves. All portions of the vegetables or fruit were placed in clean containers, completely covered with the mikroklene solution, and soaked for 30 minutes. The mikroklene solution was prepared by adding three to four ounces (one package) of compound germicidal rinse to 15 to 25 gallons of cold, clean water. This solution was used once and then discarded. After treatment, the vegetables were thoroughly rinsed in potable water. Even with these precautions, the use of fresh fruits and vegetables was limited to those obtained through authorized Quartermaster procurement. Purchase by individuals or by individual units remained prohibited.

Experience in the treatment of vegetables and fruits by chlorine solutions indicated that the method had much merit. It is to be admitted, however, that it was not subjected to adequate controlled experiment. This remains to be done.

Serving of Food.--Self-service was advocated and practiced to a considerable extent in the European Theater, principally as a means of preventing food waste. (Figure 6) The advantages were many, but the method had inherent dangers and required rigid supervision. Particular care had to be taken about men reaching into food containers. The danger in respect to food eaten at that meal was likely minimal, because of the short interval between theoretical contamination and actual ingestion of the food. The dosage would necessarily be small. The principal danger came from subsequent serving of the food as leftovers.

Food Handlers.--With due consideration of all other factors, the greatest danger of food poisoning came from the people who handled food. They were the cause of most outbreaks. The attention that was directed to carriers was with good reason, but it was a firm conclusion from this experience that more trouble came from sick persons working in kitchens than from healthy germ carriers.

EPIDEMIOLOGIC CASE REPORT NO. 18 - A most extensive outbreak of salmonella food poisoning involved only the enlisted men of the 316th Station Hospital on 2 January 1945. The source of infection could be traced with distinct assurance to the dressing of turkeys served at the evening meal, with strong suggestion of the activity of a carrier. At least one of the two cooks who prepared the dressing was determined to be a carrier of *Salmonella* Montevideo, and the same organism was found in the stools of no less than 160 patients who had eaten the food.

There can be no argument that any cook or any mess attendant or any member of the kitchen police who is ill has no business in a mess. And yet there were many considerations in the ordinary day's work of military life which acted against the enforcement of that common sense procedure. Good cooks were few. Any kind of a cook was often hard to get. There was the factor of gold bricking and the usual shortage of mess attendants. The result was a common attitude of the man being well enough to work if he wanted to.

Men with acute infectious disease, if no more than simple upper respiratory infection, were required to be excluded from duty concerned with the preparation of food, while the man with a gastrointestinal upset was recognized as a special hazard.





Figure 6

Hot Food for Combat Engineers, Hamby, France, August 1944.





EPIDEMIOLOGIC CASE REPORT NO. 19 - An outbreak of 84 cases of food poisoning at Depot G-22, 19 March 1944, brought out that one man became ill at 0900 hours on 14 March. He had chills, abdominal cramps, many bowel movements, and vomitted during the morning. This did not deter him from carrying on as KP in the mess. He finally became so ill that he reported to the dispensary, was treated, and told to go back to duty. He vomitted as he left and was too weak to return; he was still ill the following day. The outbreak of food poisoning was traced to the meal served that evening. Subsequent individual histories of 14 cooks gave evidence that six had had diarrhea within the past month, of whom two had been severely ill.

A principal deficiency was in the lack of attention given men with minor infected wounds of the hands where their duties involved preparation of foods. A furuncle or carbuncle on an exposed surface was usually understood to be a source of danger; the minor affairs not so much so, although they were frequently the apparent sources of staphylococcus food poisoning.

EPIDEMIOLOGIC CASE REPORT NO. 20 - A total of 54 men of the 555th Ordnance HM (TK) Company developed food poisoning in October 1944. The symptoms were those of staphylococcus food poisoning. An inspection of the kitchen and kitchen personnel revealed a food handler with an abscess of the neck. He was removed from this duty.

With full appreciation of the activity of carriers in food poisoning, routine stool examination of food handlers was believed to be an over-worked ritual. Theater requirements did provide for an X-ray examination of the chest as a part of the required general physical examination given food handlers, a consideration commonly neglected and believed to be of principal significance. (Figure 7) The routine serologic test for syphilis was completely eliminated. There is no evidence that venereal disease was ever transmitted by a food handler, male or female, in the rigid practice of their primary profession.

Examination of stools was dispensed with except in those instances where history or physical findings suggested an intestinal disorder. With the number of examinations thus limited, opportunity was given for more careful study of those samples associated with real suggestion of trouble; in place of the haphazard

attention which routine stool examinations usually have when they are made by the hundreds. General experience has thoroughly demonstrated the lack of result and the undue cost of such routine examinations. The only exception to this policy was under circumstances of an undue prevalence of some intestinal infection. Bacillary dysentery, for example, became so frequent among German prisoners of war in one particular locality, that none were accepted for mess duty until bacteriologic examination of the feces had been made.

The American Red Cross, in the conduct of their snack bars and club restaurants, were entirely dependent on civilian food handlers of the country in which they were located. Civilians were used to no small extent in army messes, even in the headquarters of advanced ground force units. Their control was decidedly difficult. Food handler examinations were not a common practice either in England or on the continent. Much prejudice had to be overcome, and that involved education. A food handler's examination could not be required as a basis for employment, because help was too scarce and too difficult to obtain. By gradually introducing the simplest rules and then developing an appreciation of the need for such examinations, a fair system of control of this difficult group of workers eventually came into being. The standard examination included a brief medical history of recent and chronic illnesses, with special attention to infections of the gastro-intestinal tract; physical examination of the nose and throat for evidence of infectious disease; examination of the chest for acute or chronic inflammatory conditions of the respiratory tract to include X-ray of the chest; and physical examination of the skin for evidence of communicable disease. Bacteriologic examination of stools for the infectious agents of intestinal disease was made when the medical history indicated the possibility of a carrier state, and a serologic test for syphilis was performed only when indicated by physical examination or medical history, which was not often. These regulations for civilian employees corresponded in general to those prescribed for military personnel.

Mess Kit Laundry.--Military practice has always stressed the proper washing of dishes and other eating utensils used by soldiers. Several alternative methods were provided at various installations of the theater, depending on the circumstances associated with messes and the type of operations. In static hospitals cooking and eating utensils were washed and scalded by use of dish washing machines, where the washing period was not less than 40 seconds with the temperature of the wash water held at 140°F. or higher. This was followed by rinsing for 20 seconds with the water at a temperature of not less than 180°F.

Where dish washing machines were not available, dishes and utensils were washed in soapy water and rinsed in hot water at 120° to 140°F. They were then immersed in boiling water for at least 1





Figure 7

Examination of Food Handlers, France, November 1944.



minute. When hot water was not available, the utensils and dishes were first thoroughly washed and rinsed, and then immersed for not less than 30 seconds in a chlorine solution containing at least 50 parts per million of free chlorine. All utensils were air dried. Dish towels were not used.

Mess kits were rinsed in receptacles of clean, boiling water before using. After messing, the kit was cleaned by passing it through three suitable receptacles on the basis of 3 small (about 12-gallon) containers for 125 men, or 3 large (about 24-gallon) containers for 250 men. (Figure 8) The first receptacle contained hot, soapy water and the other two clear rinse water. The mess equipment was thoroughly washed in hot, soapy water and then rinsed in the two clear waters which were kept boiling. Where facilities for adequately heating water could not be provided, the last rinse water contained at least 50 parts per million of free chlorine. The solution was made by dissolving the contents of one box of germicidal rinse in not more than 25 gallons of water. An additional container with hot soapy water, to act as a roughing dip prior to using the first container of the mess kit line proper, was often used and found desirable and advantageous. A detergent compound (Gusto) was added to hard waters to facilitate the cleansing of mess kits, utensils, and dishes. It was used in conjunction with soap on the basis of one-half to three-quarter ounces per gallon of water.

The procedure outlined above gave satisfactory results when hot water was assured. The main difficulty that arose in the field came from an inadequate source of heat. The Gold Medal Immersion heater, which was introduced into the theater by the 1st Armored Division and later came into very general use, solved a great deal of this trouble. Another practical difficulty was in respect to overloading of facilities, through use of a mess kit line by too many men. This always led to heavy contamination of the wash waters and inadequate sterilization of mess kits.

The introduction in the European Theater of a pre-boiling treatment of mess gear before entering the mess line, was believed to constitute an addition of considerable merit. (Figure 9) During active operations, mess gear must necessarily be carried on the person during the day, with resultant exposure to dirt and contamination; or if stored, it was too often accomplished under far from favorable circumstances.

Despite the unavoidable deficiencies which of necessity enter into field practice, cleaning of mess gear in the European forces was believed to have been generally good. No precise



definition of an outbreak of food poisoning as arising from that source was ever determined, although it was suspected in many instances.

EPIDEMIOLOGIC CASE REPORT NO. 21 - At the mess of the 507th Port Battalion, around 950 men normally used four mess gear wash lines composed of three soyer stoves each, with one soapy and two clear water containers. Periodically, additional men were quartered there for varying periods and represented a substantial increase in the number of men to be fed. The washing facilities did not measure up to requirements. Water for washing mess gear at the docks was heated at the mess hall and hauled down in trucks. It cooled off a great deal before being used.

As was usually true in such instances, the inadequate facilities for washing mess gear were not the only deficiencies of the mess. A common hand towel was provided in the kitchen for the mess personnel. There was improper attention to garbage cans, an excess supply of perishable food materials, and deficiencies in sewers and drainage. The vegetable storeroom was an open shed in the rear of the kitchen, and also housed the toilet.

Theater Policy of Food Procurement as a Preventive Measure.--A most important factor that contributed to the favorable rates for the diarrheas and dysenteries was the theater policy that no purchases of meats, fish, poultry, marine and dairy products would be made from commercial sources. Whole milk was not to be purchased except on specific authorization by the Chief Surgeon. Ice cream from British commercial sources was likewise prohibited. Subsequently arrangement was made whereby ice cream could be manufactured in civilian plants for American troops if the ingredients were of Quartermaster issue and of American origin. The same provisions existed on the continent. These regulations served to limit food supplies to carefully prepared products shipped from the United States.

The Control of Epidemics of Food Poisoning.--Several reasons determined the requirement of an epidemiologic study of all outbreaks of food poisoning by unit surgeons of organizations in which such incidents occurred. One was the common inclination to take such outbreaks too lightly; to consider them nothing more than an inevitable part of military life. It soon became apparent that units with a severe outbreak of food poisoning commonly tended to have recurring epidemics. The self-limited course of most outbreaks of food poisoning was appreciated. Rarely can much be accomplished in effective



Figure 8

Mess kit laundry in a unit of the XXII Corps, Munchen-Gladback, Germany, May 1945







Figure 9

Field Artillerymen sterilize their mess kits before eating, Lanfroicourt, France, October 1944.



control or limitation of a given outbreak. Much can be done in preventing recurrences, and that was the important consideration in requiring epidemiologic studies.

The prevention of disease and the control of epidemics ordinarily constitute separate and individual fields in communicable disease practice; directed to the same end, of course, but involving a difference in view point and in timing. The prevention of disease has the purpose of keeping disease from coming into existence. The control of epidemics has the objective of repairing damage already done, and of limiting losses to the fewest possible cases. The epidemiologic study of food-borne outbreaks of acute intestinal infection, realistically considered, had more to do with prevention than control.

The first objective in the study of an outbreak of food poisoning was to determine the clinical nature of the existing disease. Food poisoning is not an entity but a group of diseases. The clinical behavior of the condition often formed the basis for a logical search into sources of infection and modes of transmission. The kind of reaction experienced by patients and the length of incubation commonly suggested the nature of the causative agent.

The second step was to obtain careful food histories from all persons at risk, within the military installation. Tabulations were made of foods eaten at the last four meals, of the nature of the items included in the various menus, the presence of leftovers, and the time of serving the meals. From these basic data, the article or articles of food common to all patients were determined. Army menus were characterized by a great similarity, and experience soon indicated which particular foods were to be suspected as the most likely cause of outbreaks.

This matter of experience brought other factors of probability into play. A consideration too little appreciated by mess officers and epidemiologists was the relative risk of the several daily meals. Few outbreaks of food poisoning were related to breakfasts. It was a simple meal and usually prepared shortly before serving. The main meal of the day, dinner at noon, accounted for most epidemics, and especially those of any size. As the most pretentious meal, it was often prepared in part considerably in advance of serving. The evening meal was less commonly concerned, with midnight suppers a law unto themselves, depending largely on individual mess practice in respect to leftovers. The likelihood of festival occasions being the source of trouble has been brought out in examples already cited.



EPIDEMIOLOGIC CASE REPORT NO. 22 - Breakfast at the enlisted men's mess, Headquarters, Eighth Air Force, on 9 February 1944 consisted of grapefruit juice, scrambled eggs made from egg powder, reconstituted powdered milk, cereal and coffee. Acute food poisoning involved 33 men at about 1100 hours that morning. The outbreak was attributed to the milk, which all had taken, through its contamination by a dirty utensil or by a food handler. It had been reconstituted that morning.

Breakfast outbreaks are uncommon. Few foods served then are open to suspicion. Reconstituted milk of relatively recent preparation is not one. Powdered egg has given rise to many outbreaks similar to that described in the above case report.

At any rate, having settled on the suspected food or foods, there followed a careful investigation of the history of preparation --how long and when was the food cooked, the names of the persons who prepared it, the method of storage and all other pertinent factors. The final step was to determine the source of the infection and the nature of the infectious agent.

Identification of the bacterial cause depended upon laboratory examinations of the food and of materials from patients suffering from the disease. Bacteriologic cultures were made from feces, vomitus, and blood obtained in the acute stages of the disease. Later in the course, the blood was tested for the presence of agglutinins, and the titer compared with the level existing at the time of the outbreak or shortly thereafter. Food was examined for the presence of pathogenic bacteria. The ideal aim was to identify the infectious agent common to discharges of patients and to the food. In most instances, however, outbreaks of food poisoning came under investigation too late to obtain samples of the food actually served at the meal. Moreover, many diarrheal outbreaks were not due to infection but to intoxications, and isolation of pathogenic bacteria from the discharges of the patients would not be expected. In the rare instances where death occurred in the course of an outbreak, full information was required through examination of the body at autopsy.

Control measures do not include isolation of the ordinary patient suffering with food poisoning. The disease is shortlived and there is little danger of person to person transmission. Patients with known or suspected infection with salmonella or dysentery bacilli were of course isolated.

If epidemiologic study indicated a likely origin of the outbreak from a carrier, examination of food handlers was a significant part of the control program. In a general outbreak of food poisoning, food handlers were almost invariably among those affected. It was surprising to find how frequently action had been lacking in removing them from their duties during the acute illness and in assuring their freedom from the carrier state before returning.

If the epidemic gave indication of staphylococcus origin, search was made for minor infected lesions of the hands among food handlers. Rigid physical inspection was necessary. Evidence of recent scars often gave evidence of customary practice.

Remedial measures in respect to the mess depended upon the probable source of the infection, as determined by the epidemiologic study. Where this was not immediately and promptly evident, milk, water and suspected foods in common use were subjected to investigation and control until the definite cause could be determined.

An outbreak of food poisoning always gave excellent opportunity for a review and evaluation of messing procedures. It is an old story in epidemiology that an outbreak of any kind gives opportunity for the health officer to bring into play an improvement of general conditions not otherwise possible of accomplishment. This was one of the decided benefits derived from epidemiologic study of outbreaks of food poisoning. Final recommendations contained suggestions for eliminating future events of the same order, and for improving the general character of mess management in the unit where the epidemic occurred.





Table 1

## FOOD POISONING\*

European Theater of Operations, U. S. Army  
Cases and rates per 1000 strength per annum

February 1944 - June 1945

	Total		1944		1945	
	Cases	Rate	Cases	Rate	Cases	Rate
January	122	.6			122	.6
February	293	1.1	123	1.7	170	.8
March	96	.3	7	.07	89	.3
April	568	1.8	452	4.8	116	.5
May	237	.8	84	.8	153	.7
June	71	.2	22	.2	49	.2
July	103	.9	103	.9		
August	129	1.0	129	1.0		
September	12	.1	12	.07		
October	204	1.5	204	1.5		
November	624	4.1	624	4.1		
December	323	1.4	323	1.4		
Total	2782	1.0	2083	1.4	699	.5

\*Data were not available until February 1944.

Source: Division of Medical Statistics, Office of The Surgeon General, War Department, Washington, D.C.

Table 2

FOOD POISONING

116 Selected Epidemics Occurring in the European Theater of Operations  
U. S. Army

1943 - 1945 Inclusive

Place	Total Epidemics	Staphylo- coccus	Salmonella	Bacteriologically Unknown, Clinically and Epidemiologically			
				Staphylo- coccus Type	Salmonella Type	Indetermi- nate	Total
United Kingdom	71	11	14	29	11	6	46
Continental Europe	44	6	2	15	5	16	36
Total	115	17	16	44	16	22	82

Source: Division of Preventive Medicine, Office of The Chief Surgeon,  
European Theater of Operations, U. S. Army.

Table 3

Staphylococcus Food Poisoning, European Theater of Operations  
1943 - 1945

Outbreak	Date	Place	Food	Number Persons Involved	No. Ill	Percent Ill
190th Field Artillery	1 Sept. 1943	United Kingdom	Chocolate Pudding		44	
1512th Quartermaster Battalion	20 Oct. 1943	United Kingdom	Canned Tongue and Corned Beef Hash		29	
135th General Hospital	29 July 1944	United Kingdom	Bread Pudding		74	
102nd General Hospital	24 Aug. 1944	United Kingdom	Rice Pudding	Patients and Unit	219	
485th (GS) Engineer Regiment	23 Nov. 1944	Continent	Turkey and Gravy		118	
1930th Ordnance Ammu- nition Co. (AVN)	23 Nov. 1944	Continent	Turkey, Dressing, Peas, Ice Cream	182	72	40
Depot E-508 P	24 Nov. 1944	Continent	Turkey, Ice Cream		50	
AAF Station #541	3 Dec. 1944	United Kingdom	Ice Cream		11	
Base Air Depot #2	7 Dec. 1944	United Kingdom	Pork Sausage		48	
166th General Hospital	4 Jan. 1945	Continent	Rice Pudding	240	20	15



Table 3 Cont'd.

Staphylococcus Food Poisoning, European Theater of Operations  
1943-1945

Outbreak	Date	Place	Food	Number Persons Involved	No. Ill	Percent Ill
Malpas Court Camp	9 Jan. 1945	United Kingdom	Identity Unknown		136	
556th Quartermaster Battalion	15 Feb. 1945	Continent	Canned Beans	352	88	25
12th Replacement Depot	20 Feb. 1945	United Kingdom	Bread Pudding	1003	349	35
825th Convalescent Center	25 Feb. 1945	United Kingdom	Sausage		17	
241st General Hospital	21 Mar. 1945	Continent	Bread Pudding			33
192nd General Hospital	8 Apr. 1945	United Kingdom	Ice Cream		399	
112th General Hospital	14 Apr. 1945	United Kingdom	Rice Pudding	Approx. 500	101	20

Table 4

## Salmonella Food Poisoning

European Theater of Operations, U. S. Army

1943 - 1945

Unit	Date	Place	Food	Origin	Number Persons Involved	No. Ill	Per- cent Ill
175th Infantry Division	30 Jan. 1943	United Kingdom	Salmon	S. enteritidis (Gaertner)	1200	42	
825th Engineer Aviation Battalion	May 1943	England	Butterscotch Pudding	S. suipestifer		67	
342nd Engineer Regiment, G. S.	1 Aug. 1943	England	Faulty washing of mess gear on range	S. aertrycke	1 Co.	5	
101st Airborne Division	Oct. 1943	United Kingdom	Left-over potatoes	Salmonella		61	
453rd Amphibious Truck Company	22 Dec. 1943	United Kingdom	Identity unknown	S. Montevideo		23	
79th General Hospital	11 Apr. 1944	North Ireland	Rice Pudding	S. Montevideo		354	
314th Station Hospital	17 Apr. 1944	England	Identity unknown	S. Montevideo		81	
15th Tank Battalion, Camp D-6	15 July 1944	United Kingdom	Identity unknown	S. group		40	

Table 4 Cont'd.

## Salmonella Food Poisoning

## European Theater of Operations, U. S. Army

1943 - 1945

Unit	Date	Place	Food	Origin	Number Persons Involved	No. Ill	Per- cent Ill
278th Signal Pigeon Company	22-24 Oct. 1944	Continent	Identity unknown	S. aertrycke	150	50	
96th General Hospital	5 Nov. 1944	England	Pumpkin Cobbler	Salmonella	976	652	
58th Armored Infantry Battalion	26 Nov. 1944	England	Turkey and Dressing	S. Newport		77	
302nd Transport Wing	3 Dec. 1944	United Kingdom	Rice Pudding	S. schottmulleri	Hq & Hq Sgdrn	119	
316th Station Hospital	2 Jan. 1945	United Kingdom	Turkey	S. Montevideo		200	
10th Station Hospital	14 Feb. 1945	United Kingdom	Identity unknown	Salmonella		27	
486th Ordnance Evacuation Company	16 Feb. 1945	Continent	Identity unknown	S. suispestifer		30	
Depot, G-45	8 Apr. 1945	United Kingdom	Mashed potatoes	Salmonella		29	



Table 5

Epidemic of Food Poisoning

Salmonella Montevideo

79th General Hospital, North Ireland

Distribution of cases by days

April 1944

Date	Number Cases
11 April 1944	28
12 April 1944	257
13 April 1944	63
14 April 1944	6
Total	354

Source: Division of Preventive  
Medicine, Office of the  
Chief Surgeon, European  
Theater of Operations.

Table 6

Salmonella Strains in American  
Dried Eggs

Type	Percent
Bact. Orienienburg	42
Bact. Montivedeo	18
Bact. Bareilly	8
Bact. anatum	7
Bact. meleagridis	5
Bact. typhimurium	3
Bact. Worthington	3
Bact. London	2
Bact. Derby	2
Bact. bovis-morbificans	1
*Incompletely identified	10

\*Two strains remain incompletely identified. Of the others most were subsequently identified as Bacterium Tennessee. Other types since identified include Thompson, gallinerum, Newport, Minnesota, and Bredeney.

Source: Emergency Public Health  
Laboratory Service, Ministry  
of Health, Great Britain.

Table 7  
Outbreaks of Food Poisoning in England and Wales  
1923-19 October 1943  
By Type of Salmonella Isolated

Salmonella	1923-39	1940	1941	1942	1943	Total
<u>Bact. typhimurium</u>	228	31	35	24	48	366
<u>Bact. enteritidis</u>	52	16	6	8	10	92
<u>Bact. Thompson</u>	47	25	23	8	10	113
<u>Bact. Newport</u>	28	10	3	8	10	59
<u>Bact. cholerae-suis</u>	14	-	2	3	-	19
<u>Bact. bovis-</u> <u>morbificans</u>	8	2	-	2	4	16
<u>Bact. Dublin</u>	7	9	1	2	1	20
<u>Bact. Potsdam</u>	3	2	2	-	-	7
<u>Bact. Senftenberg</u> (Newcastle)	3	1	-	1	1	6
<u>Bact. Derby</u>	2	-	-	-	2	4
<u>Bact. Stanley</u>	1	-	1	-	-	2
<u>Bact. Eastbourne</u>	2	-	-	-	-	2
<u>Bact. London</u>	1	10	-	-	-	11
<u>Bact. Aberdeen</u>	2	1	2	-	-	5
<u>Bact. gallinerum</u>	-	1	-	-	-	1
<u>Bact. Newington</u>	-	1	-	-	-	1
<u>Bact. Orienienburg</u>	-	-	-	11	24	35
<u>Bact. Montevideo</u>	-	-	2	1	13	16
<u>Bact. anatum-like</u>	-	1	-	3	2	6
<u>Bact. Bareilly</u>	-	-	-	1	3	4
<u>Bact. Reading</u>	-	-	2	-	-	2
<u>Bact. Braendorup</u>	-	-	-	1	-	1
<u>Bact. Oslo</u>	-	-	-	1	-	1
<u>Bact. Virchow</u>	-	-	-	1	-	1
<u>Bact. Chester</u>	-	-	-	-	3	3
<u>Bact. Kentucky</u>	-	-	-	-	2	2
<u>Bact. Muenchen</u>	-	-	-	-	1	1
<u>Bact. meleagridis</u>	-	-	-	-	4	4
<u>Bact. San Diego</u>	-	-	-	-	6	6
<u>Bact. sundsvall</u>	-	-	-	-	4	4
<u>Bact. Tennessee</u>	-	-	-	-	3	3
Unidentified	12	2	6	1	2	23
Total	410	112	85	76	153	836

Note: Except for one strain of gallinerum, one Newington, and one anatum-like organism, upper half of table shows types met with before, and lower half since importation of American dried egg into Great Britain.

Source: Ministry of Health, Great Britain.



Table 8

Strains of Salmonella from Patients with  
Food Poisoning  
United States Army in Great Britain  
1943

Salmonella	Month	Source
<u>anatum</u> group	May	2nd General Hospital
<u>bovis-</u> <u>morbificans</u>	June	Cambridge E. P. H. Laboratory
<u>Kentucky</u>	June	2nd General Hospital
<u>meleagridis</u>	October	2nd General Hospital (2 Cases)
<u>Montevideo</u>	May	2nd General Hospital
	June	2nd General Hospital
	July	3rd General Dispensary
	September	3rd General Dispensary
	October	3rd General Dispensary
<u>Newport</u>	June	2nd General Hospital
	October	2nd General Hospital
<u>Orienienburg</u>	February	2nd General Hospital
	April	2nd General Hospital
	May	2nd General Hospital (2 Cases)
	May	3rd General Dispensary
	August	2nd General Hospital
	September	2nd General Hospital (2 Cases)
<u>Tennessee</u>	June	2nd General Hospital
<u>typhimurium</u>	August	2nd General Hospital (2 Cases)
<u>enteritidis</u>	February	Winchester E. P. H. Laboratory (2 Cases)

Source: Emergency Public Health Laboratory Service,  
Oxford, England, 19 October 1943.

## FIGURES

1. Epidemic of Food Poisoning, Salmonella Montevideo, 79th General Hospital, North Ireland, Distribution of cases by days, April 1944.
2. Thanksgiving Turkey served to combat men, Continental Europe, November 1944.
3. Transient Mess, Lerouville, France, June 1945.
4. Kitchen stoves as Storage Places for Cooked Food, 155th General Hospital, England, 1944.
5. Food Conservation, Oise Section, Communication Zone, June 1945.
6. Hot Food for Combat Engineers, Hamby, France, August 1944.
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8. Mess kit laundry in a unit of the XXII Corps, Munchen-Gladback, Germany, May 1945.
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3. Staphylococcus Food Poisoning, European Theater of Operations, U. S. Army, 1943 - 1945 Inclusive.
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7. Outbreaks of Food Poisoning in England and Wales, 1923 - 19 October 1943, By type of Salmonella Isolated.
8. Strains of Salmonella from Patients with Food Poisoning, U. S. Army in Great Britain, 1943.



## EPIDEMIOLOGIC CASE REPORTS

1. Staphylococcus epidemic from preparing food too long in advance.
2. Botulism from canned ravioli.
3. Botulism from home canned pickles of German origin.
4. Salmonella epidemic from rice pudding.
5. Salmonella outbreak with pigeons the suggestive source of infection.
6. Food poisoning from Christmas dinner.
7. Food poisoning from Thanksgiving dinner.
8. Turkey on New Years Day.
9. Salmonella infection from egg nog.
10. Salmonella infection from cooked powdered egg.
11. Food poisoning from scrambled egg.
12. Food poisoning from unsatisfactory sanitary conditions.
13. Food poisoning epidemic with flies suggestive contributing influence.
14. Food poisoning from contaminated food ingredients.
15. Food poisoning from storing food on stove.
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17. Food poisoning from left-over foods.
18. Food poisoning from salmonella carrier.
19. Food poisoning arising from patients with diarrhea serving as mess attendants.
20. Staphylococcus carrier in food poisoning.
21. Deficiencies in mess kit laundry as a source of food poisoning.
22. Breakfast outbreak of food poisoning.





A HISTORY OF PREVENTIVE MEDICINE  
IN THE  
EUROPEAN THEATER OF OPERATIONS  
UNITED STATES ARMY  
1941 - 1945

PART III - Epidemiology

Section 2 - Intestinal Infections

Number 3 - Typhoid and Paratyphoid Fevers  
Control of Intestinal Infections

by

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## PART III

### Epidemiology

#### Section 2 - Intestinal Infections

#### Number 3 - Typhoid and Paratyphoid Fevers Control of Intestinal Infections

Typhoid Fever.--It is an odd circumstance, even in a present day account of a military experience with intestinal infections, to find typhoid fever bringing up the rear. Nevertheless, it does; and on just about every count -- in respect to numbers of cases and deaths; from a military standpoint in respect to days lost from duty; and in medical interest both clinically and epidemiologically. Many others of the health records established by the European theater were more spectacular, but none was basically more astonishing than that there were in an army which reached a maximum strength of 3,064,562 no more than 46 cases of typhoid fever over a 4-year period. The attack rate was 0.014 per thousand strength per annum. For troops of the United States Army serving in France during World War I the rate was 0.530.

The distribution of cases by years and by months is set forth in Table 1. The number of cases is so small as to give no indication of the usual seasonal prevalence of the disease, except in the last year of the experience.

Special Epidemiological Studies.--The source of the data for typhoid fever differs from the general origin of most statistical information presented in this discussion, in that reports and special investigations of the division of Preventive Medicine of the Office of The Chief Surgeon were the basis instead of the Statistical Health Reports.

Typhoid fever ranked high among special interest in epidemiology. All reports of that disease coming to the Medical Records Division on the usual Form 86ab were submitted specially to the Epidemiology Branch for individual investigation. The results of these studies were combined with the information gained from all other sources available to the Preventive Medicine Division, to give the figures presented in Table 1.

Incidence of Typhoid Fever in the European Theater.--The number of cases for the four years as reported by the Statistical Health Report was 63. There are a number of important errors of omission, as well as the inclusion of cases proved not to be typhoid or not chargeable to the American Army, such as infections



among civilians or displaced persons. Considering each year in succession, no case of typhoid fever was included in the reports by Form 86ab in 1942, and yet an individual case record showed one patient with typhoid to have been admitted to a U.S. Army hospital in North Ireland. The case is listed in Table 1.

Both series of reports contain one case in 1943. It is to be noted that this patient was not properly chargeable to the European Theater, in that he became ill on board ship in transit from Sicily with his unit and was admitted to hospital on arrival in the United Kingdom.

Cases of 1944 included 17 in the Form 86ab series, 23 in that of the authenticated data. Six cases of the first series were eliminated; one because it was a second report of the case included under December, 1943, one a typhoid carrier was not a case; another reported through a clerical error, one a Coldstream Guard admitted to an American hospital, one a displaced person, and the sixth a prisoner of war. Through knowledge of the arrival at Marseilles from Oran of a transport carrying patients with typhoid fever, an additional twelve cases were added to the remaining eleven to make a total for the year 1943 of 23 cases. The group of 12 patients received into this theater should properly be charged against the Mediterranean area; but inasmuch as a general reallocation of cases of communicable disease was not practiced, they were received into the European totals.

The discrepancy between the two series in 1945 was also well marked. The first series included 45 patients, the second 21. The difference came about through inclusion in the 86ab series of 15 prisoners of war with typhoid fever, and two displaced persons. This was in addition to five American soldiers originally suspected of typhoid infection but ultimately found to be suffering from other disease, and two instances of severe reaction to typhoid immunization.

The geographic distribution of cases showed one infection to have been contracted in North Ireland, four in Great Britain, 28 on the European continent, and 13 patients to have been received into the theater already ill with typhoid or in the incubationary stage. The 28 continental cases included 7 from France in 1944 and five more in 1945; one from Belgium and one from Luxembourg; and 14 from Germany. The thirteen patients admitted into the theater with typhoid fever were all from the Mediterranean area, 12 from North Africa and one from Sicily.

If the typhoid record of the European theater were based on cases properly chargeable against that command, in that infection arose within territory under its control, the number of typhoid cases during the four years would be 33, and the rate per thousand strength per annum 0.010.

Two of the 46 patients with typhoid fever died, one in September of 1944 and the other in March 1945. Both infections were contracted in the course of operations on the continent. They were confirmed bacteriologically and in one instance by autopsy. One patient gave a history of drinking water from an unauthorized source two weeks before onset. No information was available as to the possible source of infection for the second. The status of vaccination was also undetermined. The average mortality for typhoid fever over the total period of the European theater was 0.00063 per thousand strength per annum.

Sources of Infection.--The first case of typhoid fever occurred in North Ireland in March 1942. Only five cases of typhoid occurred among troops stationed in Great Britain in the course of four years. All were sporadic infections of which the following is typical:

EPIDEMIOLOGIC CASE REPORT, NO. 1. Corporal N., 67th Fighter Wing, AAF, reported to sick call 18 September 1944 with symptoms of fever, nausea, diarrhea, and pain in the right lower quadrant, of a duration of three to four weeks. The Widal reaction was demonstrated to be positive on 23 September. The patient was married to an English girl who lived on a farm near his station. She and other members of her family had experienced an unexplained fever during the time of the soldier's illness. During August and September there were five civilian typhoid notifications from the same community. Corporal N. received his initial typhoid vaccination in July 1943 and had had a stimulating dose of vaccine 12 July 1944.

Typhoid fever on the European continent followed the same pattern as in the United Kingdom, in that all cases represented sporadic infections. Case studies were always made, but the results were minimal so far as determining sources of infection. The army was a moving army and by the time a man became ill, he and the medical officer who made the epidemiologic study were usually miles away from where infection took place. A history of drinking water or taking food from unauthorized sources could usually be obtained but the significance of such information usually remained undetermined.



The following is illustrative:

EPIDEMIOLOGIC CASE REPORT NO. 2. Pfc. L.K., 143rd Infantry, was AWOL from his organization from the first week in October until 19 February 1945. During that time he was living with a French civilian and eating and drinking water from civilian sources. His last typhoid vaccination had been received in August 1944, as reimmunization after a preceding series. Becoming ill, he returned to his unit and was admitted to hospital the same day. Three days later, blood and stool cultures were found to contain *Eberthella typhosa*.

The only grouping of cases in the entire experience was that of the twelve patients who arrived by ship from Oran.

Previous Immunization Status.--Satisfactory information on previous immunization status was obtained for 31 patients; with 15 remaining unknown by reason of absent records, inability of the patient to remember, or failure on the part of the medical officer to inquire. All 31 soldiers who gave definite histories had been immunized against typhoid, and only two had failed to meet current requirements of either a stimulating dose or an original series within one year. One instance of typhoid after proper immunization is illustrated.

EPIDEMIOLOGIC CASE REPORT NO. 3. 2nd.Lt. J.J. was one of three officers in American Military Government living at Buchen, Germany. He was admitted to hospital 29 June 1945 with an acute illness of four days duration, which was confirmed as typhoid fever by stool and blood culture. Typhoid was stated by German physicians to be endemic in the area, with 13 cases then existing in a village four miles distant. Displaced persons served as mess attendants. The patient had travelled in Czechoslovakia two weeks prior to becoming ill. The source of infection remained undetermined. The original series of typhoid inoculations was completed 9 October 1942, a stimulating dose was administered 11 November 1943 and a second on 14 July 1944.

Laboratory Confirmation of Typhoid Infections.--The clinical diagnosis of typhoid fever was known to have been substantiated by laboratory examination of blood or stools, or by satisfactory serologic reactions, for 40 of the 46 cases. Information was lacking for four. Of two others determined as typhoid in the absence of laboratory confirmation, a review of



the clinical histories left frank skepticism as to their typhoidal nature. They were nevertheless included as typhoid in this tabulation.

Typhoid in Civilian Populations of Continental Europe.--The relative freedom of American troops from typhoid fever did not arise from lack of opportunity for exposure. The disease was particularly prevalent in France, in Belgium and Holland, and in Germany during military operations in those countries. It was present in many places where large numbers of American troops were stationed. For example, the city of St. Etienne had 570 cases with 27 deaths in the autumn of 1944. The city of Greater Liege, Belgium, had 104 cases, with the commune of Seraing an additional 44 for the period of 1 August 1944 to 18 November 1944. That a military population cannot continually escape typhoid while operating in a typhoid infected region is attested by the experience of the British forces near Caen where in the period 2 September to 11 September 1944, 68 cases were reported to have occurred in a brigade headquarters, in addition to those of two officers who visited the headquarters on 25 August 1944 and had one or two meals there. All patients had been immunized against typhoid fever.

Typhoid in Various Theaters of Operation, World War II.--The rates for typhoid fever attained by the European Theater were by no means exceptional. The experience of the nine theaters of operation of the United States Army was much the same throughout the world. (Table 2).

The Alaskan Theater had no typhoid fever. The rates for the North American, Latin American, Pacific Ocean Area and European theaters were on a par. The highest rate for a theater of operations was that of the Asiatic Theater. The rate for domestic troops of continental United States was 0.01 per 1000 per year. It is to be noted that the number of cases and the rates recorded in Table 2 for the European Theater are derived from the Statistical Health Report, and are known to contain inaccuracies. The corrected rate for the European Theater is 0.014 and the number of cases 46. (Compare Table 1).

Typhoid Fever among Prisoners of War, ETO.--The rapidly increasing incidence of the diarrheas and dysenteries that began among prisoners of war in late April and came into full play during May, gave certain indication that difficulties were ahead in respect to the typhoid and paratyphoid fevers. The record of prisoners of war in respect to the two latter diseases had been excellent during the early months of the campaign, as good as that of the American Army. The German Army was well immunized, and as long

as an acceptable minimum of environmental sanitation was maintained, prisoners remained free from typhoid infection. Accumulated evidence from many sources has led to the conviction that immunization against typhoid fever will not stand up in the face of extreme deficiencies in sanitation. It didn't in World War I. It has not in other situations. Many epidemiologists have long supported the doctrine that immunization against typhoid fever is to be considered an accessory protective measure of distinct and very great value, but that the control of the disease is fundamentally dependent on sanitary discipline.

The conditions in May 1945 that gave rise to such undue and exceptional prevalence of diarrheal disease inevitably had an effect on the typhoid rate. There was some indication of this in April. May brought realization. (Table 3). The usual frequency of typhoid fever in the German Army is not yet a matter of record. Medical intelligence indicated that it was decidedly at a low level. The conditions associated with the breakup of the German Army undoubtedly led to an increased frequency of the disease in the latter part of April. At least there were numerous admissions to hospital for typhoid fever among recently taken prisoners. Individual case reports for all patients represented in Table 3 are not available, but the date of admission to hospital was determined for 415. The distribution by days, for the months of May and June, is presented in Figure 1, Table 4.

Prisoner of war patients with typhoid fever were admitted to American hospitals every day throughout the first ten days of May. The number was 17 on 2 May 1945. Prisoners were being received during those days literally by hundreds of thousands. Not all of the patients with typhoid fever were newly captured prisoners, but many were. The number of cases was far greater than had characterized the experience of the preceding month of April or indeed the last week of April. That not many infections had originated from prisoners who had been held for appreciable periods in prisoner of war enclosures, was shown by the appreciable decline in numbers of reported cases in the second week of May. About the twenty-first of May, essentially two weeks after the flurry that marked the early days of the month, the number of new patients began to increase but not to any great extent, although the last week of May saw what under ordinary circumstances would have been considered a fair-sized epidemic of typhoid fever, judged by present day standards. There followed a brief lull and then the full force of the epidemic struck, marking what was essentially the third wave of increased prevalence. The number of admissions mounted steadily through the second week of June, to reach a peak of maximum frequency on 11 June 1945



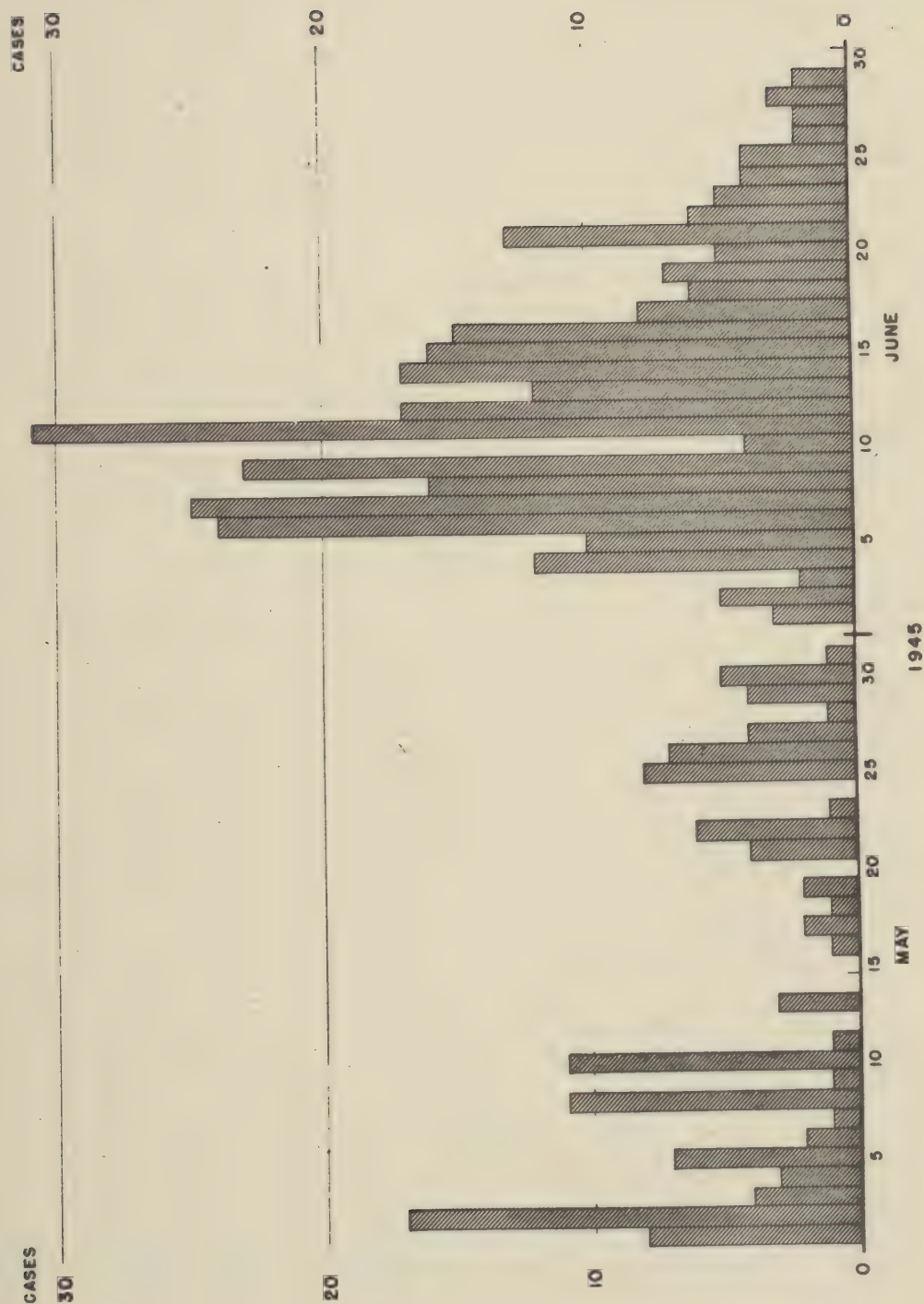


Figure 1. Typhoid Fever among 415 Prisoners of War in the European Theater of Operations. Distribution by day of admission to hospital, May and June 1945.





with 31 reported cases. The distribution by days tapered off gradually in the succeeding two weeks to a point where the last days of the month saw a daily admission of only two or three patients.

This sample of 415 patients is believed representative of the 482 reported as typhoid fever in the months of May and June. The two series set forth in Tables 3 and 4 differ in time distribution, because the first is by day of report as typhoid fever and the second by day of admission to hospital.

In a number of instances the source of infection could be determined as lying within some particular part of the chain of evacuation from the front to the rear. Prisoners were ordinarily held for a few days in forward collecting cages, then moved toward the rear to a collecting point, and eventually evacuated to the larger camps well within a base section. Certain collecting points, gave good evidence of being the point of origin for the numerous cases of typhoid fever which developed in permanent prisoner of war camps some two weeks later.

EPIDEMIOLOGIC CASE REPORT NO. 4. Prisoner of War Enclosure No. 11 was a collecting point in Normandy Base Section for prisoners of war captured in Germany. Three prisoners of war received on 6 June 1945 were ill on arrival with a disease characterized by severe headache, prostration, and high fever. The next day nine more men reported ill, and thereafter daily additions were made to the roster of patients with a similar disease; so that by 25 June 1945 the number was 101. About a third of the patients had a rash of the abdomen, not affecting the extremities, face or back; and the fever was typhoidal in type. The infectious process was confirmed by laboratory examinations as typhoid fever in a significant proportion of patients; and by pathologic examination after death in a number of instances. Most of the prisoners had been captured in Germany about the first of May. They had been held in various enclosures in Germany and then forwarded to the Normandy concentration point. Those with typhoid fever were in large part from PWTE, A7, near Welgesheim, but a number of different enclosures were represented. In general, they had left Germany in the early days of June and had arrived in Normandy between 4 June 1945 and 8 June 1945. There had been no previous typhoid fever in the Normandy camp, and the period of incubation would indicate that in most instances the

infection had been acquired after capture and in prisoner of war enclosures near the front lines.

In some instances a carrier origin of infection could be determined. The epidemic would seem to have arisen from sources within German troops, and to have been disseminated to the extent that it was, largely because of the conditions incident to the end of the war. The breakup of the German Army, the crowding of prisoner of war enclosures and the loss of sanitary discipline were the important contributing factors.

The only available information on deaths from typhoid fever among prisoners of war comes from the records of the Advance Section of the Communications Zone, where among 403,142 prisoners there were 30 deaths from typhoid in the six week period from 1 May 1945 to 15 June 1945.

As would likewise be anticipated, the incidence of paratyphoid fever increased in parallel fashion with that for typhoid fever; so that there were 416 cases reported for the months of May and June, to give a rate essentially that of typhoid fever.

Paratyphoid Fever.--The record of the European theater in respect to the paratyphoid fevers was even better than that for typhoid. The data are included in Table 5. No cases occurred in 1942. There was one case in 1943 and four in 1944. The experience of paratyphoid paralleled that of typhoid in 1945, when more cases occurred during that year than in all others combined, 11 cases. The total for the four years was 16, and the average rate per thousand strength per annum for the total theater period was 0.005. The number of cases occurring in Great Britain was two, and on the continent 14. The distribution of the latter included six infections contracted in France, four in Germany, three in Luxembourg and one in Belgium.

Like the data presented for typhoid fever, the information in respect to paratyphoid fever is drawn from special reports to the Division of Preventive Medicine. The number of cases reported in the 86ab series was appreciably greater, 56, with many instances where the tentative diagnosis of paratyphoid fever was changed to some other disease condition. There were a number of prisoners of war included. (Table 6)

All cases of paratyphoid fever represented sporadic infections, except for a single instance where two patients from the same unit developed the disease, the 168th General Hospital. All cases included in this experience were confirmed bacteriologically as paratyphoid fever. Twelve were paratyphoid B, and two



paratyphoid fever A. No deaths were noted in medical records of the theater.

Prevention and Control of the Intestinal Infections.--Specific preventive measures exist only for typhoid fever and the paratyphoid fevers A and B. All troops were immunized against these conditions as prescribed by existing regulations, and continued effort was directed toward assuring by report and inspection that full protection was maintained by reimmunization at the required intervals. The details of methods practiced in the European Theater are given in the section of this account devoted to specific immunization. General preventive measures constituted the main reliance in maintaining rates for intestinal infections at a respectable level. This applied to typhoid and paratyphoid fevers as well as to diseases lacking a specific protective agent.

The early diagnosis and isolation of patients with intestinal infection was considered as fundamental to good control as to good medical practice. The success of both was largely governed by the promptness with which the disease was recognized. Early diagnosis was facilitated by publication from time to time in the theater Medical Bulletin of diagnostic criteria for the intestinal infections, and information on laboratory aids to diagnosis. Isolation was regularly practiced for typhoid fever, paratyphoid fever and dysenteries, but not for common diarrhea nor for patients with food poisoning.

The relative ease of access of most units of the theater to laboratory facilities permitted satisfactory accomplishment in the search for carriers and in their successful discovery. Carriers were managed in accordance with the measures prescribed in army regulations.

The necessary precautions to prevent contamination of food have been discussed in connection with food poisoning. The sources and modes of infection, and the methods of interrupting transmission, were recognized there as by no means individual to those conditions. They apply equally to the limitation of food borne infection by members of the intestinal group of pathogenic bacteria. With modern environmental sanitation and the control of water supplies what it is, food is perhaps the single most important consideration, unless it be carriers. The primary control of messes was the function of unit commanders but unit surgeons were greatly aided by the activity of the numerous nutrition officers of the theater, who took a great interest in mess management. The specialized knowledge and emphasis which these experts

brought to various units served to broaden and extend the level of accomplishment.

The proper safeguarding of water supplies has reached such a standard in military practice that a tendency exists to relegate its importance to secondary consideration. It is no less important as a potential source of infection than are foods. Foods occupy the place they do only because breaks in technic are more frequent and the methods of assuring satisfactory performance are not as well defined. The general procedures that were employed in the theater are given in detail in the section of this history devoted to sanitation. It is only necessary here to mention the special measures instituted in continental operations in areas of particular risk of amebic dysentery. A coagulant was directed to be used by the standard mobile or portable water purification units for the treatment of surface waters in such amount as to give a heavy rapidly settling floc. A minimum settling period of one hour was required for the batch system, using two sedimentation tanks. This involved use of three canvas water tanks, two for treatment and one for storage for each water purification unit. Filter output was restricted to ten gallons per minute for portable units. Chlorination was applied in such way as to maintain a residual of at least one part per million in accordance with standard practice. When using Lyster bags and calcium hypochlorite (Grade A) ampules with surface waters not previously filtered, the chlorine dosages were required to be sufficient to produce one part per million chlorine residual after 10 minutes contact. In addition, one ampule of calcium hypochlorite was added immediately after the chlorine residual test and an additional contact period of 30 minutes allowed before using the water.

The efforts directed toward destruction of flies and the prevention of fly breeding met many difficulties. Screening of hospitals and camps, to say nothing of private dwellings, was not a regular practice in Great Britain. Construction specifications for new units to be provided for the United States Army, required screening of kitchens, mess halls and food storage rooms but the level of accomplishment was not always good. The same situation held for conditions on the continent. The addition of D.D.T. to methods of fly control gave a method of great practical value under the existing conditions. Flies were bad in a number of units from time to time but the problem was ordinarily one of local nature. In general the level of fly control was probably as good in the European Theater as it ordinarily is in civilian practice in the United States.

The disposal of human wastes constituted the final part of the general program for prevention of the intestinal infections. Again reference is made to the section on sanitation for the details of the methods employed.





Table 1

Typhoid Fever

European Theater of Operations, U.S. Army

Cases and rates per 1000 strength  
per annum, by month and year

February 1942 - June 1945 Inclusive

Month	Total	1942	1943	1944	1945
January	4	-	-	3	1
February	1	-	-	-	1
March	6	1	-	-	5
April	3	-	-	-	3
May	3	-	-	-	3
June	8	-	-	-	8
July	-	-	-	-	
August	-	-	-	-	
September	4	-	-	4	
October	-	-	-	-	
November	13	-	-	13	
December	4	-	1	3	
Total	46	1	1	23	21
Rate	.014	.014	.004	.009	.015

Source: Division of Preventive Medicine,  
Office of the Chief Surgeon, ETOUSA.

Table 2

## Typhoid Fever

Total Army, Continental United States and Theaters of Operations

U. S. Army, Cases and Rates per 1000 Strength

per annum, January 1942 to June 1945, inclusive

Theater	Total		1942		1943		1944		1945	
	Cases	Rates	Cases	Rates	Cases	Rates	Cases	Rates	Cases	Rates
Total Army	528	.02	44	.01	157	.02	216	.03	111	.03
United States	89	.01	23	.01	37	.01	23	.01	6	.004
Overseas	439	.05	21	.04	120	.08	193	.06	105	.04
China Burma India	93	.28	8	1.42	21	.46	51	.32	13	.11
African Middle East	23	.18	2	.35	12	.22	8	.17	1	.04
Mediterranean Theater	164	.12	0	0	62	.14	97	.15	5	.02
Southwest Pacific Area	73	.06	4	.06	17	.09	14	.03	38	.10
Latin America	9	.03	5	.05	4	.03	0	0	0	0
European Theater	33	.02	0	0	1	.00	17	.01	45	.03
North America	2	.01	0	0	1	.01	1	.02	0	0
Pacific Ocean Area	12	.01	2	.01	2	.01	5	.01	3	.01
Alaska	0	0	0	0	0	0	0	0	0	0

Source: Division of Medical Statistics, Office of the Surgeon General, War Department, Washington, D.C.



Table 3

Typhoid and Paratyphoid Fevers

Prisoners of War, European Theater of Operation,

U. S. Army

September 1944 to June 1945, Inclusive.

Month	Typhoid Fever		Paratyphoid Fever	
	Cases	Rates	Cases	Rates
1944				
September	—	—	—	—
October	2	.3	1	.2
November	—	—	—	—
December	—	—	—	—
1945				
January	—	—	—	—
February	—	—	—	—
March	2	.1	—	—
April	7	.1	3	.05
May	29	.3	4	.04
June	453	2.4	412	2.2
TOTAL	493	1.1	420	.9

Source: Division of Preventive Medicine, Office of the  
Chief Surgeon, ETOUSA.

Table 4

Typhoid Fever Among Prisoners of War  
European Theater of Operations, U.S. Army  
Distribution by day of Admission to  
Hospital of 415 Patients  
May and June 1945

Day	Number	Day	Number	Day	Number
May 1	8	May 21	4	June 10	4
" 2	17	" 22	6	" 11	31
" 3	4	" 23	1	" 12	17
" 4	3	" 24	0	" 13	12
" 5	7	" 25	8	" 14	17
" 6	2	" 26	7	" 15	16
" 7	1	" 27	4	" 16	15
" 8	11	" 28	1	" 17	8
" 9	1	" 29	4	" 18	6
" 10	11	" 30	5	" 19	7
" 11	1	" 31	1	" 20	5
" 12	0	June 1	3	" 21	13
" 13	3	" 2	5	" 22	6
" 14	0	" 3	2	" 23	5
" 15	0	" 4	12	" 24	4
" 16	1	" 5	10	" 25	4
" 17	2	" 6	24	" 26	2
" 18	1	" 7	25	" 27	2
" 19	2	" 8	16	" 28	3
" 20	0	" 9	23	" 29	2
				-----	--

Source: Division of Preventive Medicine, Office of the Chief Surgeon, ETOUSA

Table 5

Paratyphoid Fever

European Theater of Operations, U.S. Army

Cases and rates per 1000 strength per annum,  
by month and year

February 1942 to June 1945 Inclusive

Month	Total	1942	1943	1944	1945
January	-	-	-	-	-
February	3	-	-	-	3
March	1	-	-	-	1
April	3	-	1	-	2
May	1	-	-	-	1
June	4	-	-	-	4
July	-	-	-	-	
August	-	-	-	-	
September	1	-	-	1	
October	-	-	-	-	
November	-	-	-	-	
December	3	-	-	3	
Total	16	-	1	4	11
Rates	.005	-	.004	.003	.008

Source: Division of Preventive Medicine,  
Office of the Chief Surgeon  
European Theater of Operations,  
U. S. Army.



Table 6

Paratyphoid

Total Army, Continental United States and Theaters of Operations

U. S. Army, Cases and Rates per 1000 Strength

per annum, January 1942 to June 1945, inclusive.

Theater	Total		1942		1943		1944		1945	
	Cases	Rates	Cases	Rates	Cases	Rates	Cases	Rates	Cases	Rates
Total Army	650	.03	76	.02	165	.02	180	.02	229	.06
United States	71	.01	15	.01	20	.00	29	.01	7	.005
Overseas	579	.07	61	.12	145	.09	151	.04	222	.09
African Middle East	80	.61	52	9.06	13	.24	15	.32	0	0
China Burma India	81	.24	1	.18	11	.24	45	.28	24	.20
Latin America	68	.19	6	.06	49	.41	11	.13	2	.05
Southwest Pacific Area	116	.10	0	0	22	.11	12	.02	82	.21
Mediterranean Theater	103	.08	0	0	45	.10	49	.07	9	.04
Pacific Ocean Area	74	.07	1	.01	3	.01	6	.02	64	.31
Alaska	1	.004	0	0	0	0	0	0	1	.04
European Theater	56	.02	1	.01	2	.01	13	.01	40	.03
North America	0	0	0	0	0	0	0	0	0	0

Source: Division of Medical Statistics, Office of the Surgeon General, War Department, Washington, D.C.

## FIGURES

1. Typhoid Fever among 415 Prisoners of War in the European Theater of Operations, Distribution by day of admission to hospital, May and June 1945.





## TABLES

1. Typhoid Fever, European Theater of Operations, U.S. Army, Cases and rates per 1000 strength per annum, by month and year, February 1942 to June 1945 Inclusive.
2. Typhoid, Total Army, Continental United States and Theaters of Operations, U. S. Army, Cases and Rates per 1000 Strength per annum, January 1942 to June 1945, Inclusive.
3. Typhoid and Paratyphoid Fevers, Prisoners of War, European Theater of Operations, U. S. Army, September 1944 to June 1945, Inclusive.
4. Typhoid Fever among Prisoners of War, European Theater of Operations, U. S. Army, Distribution by day of admission to hospital of 415 patients, May and June 1945.
5. Paratyphoid Fever, European Theater of Operations, U. S. Army, Cases and rates per 1000 strength per annum, by month and year, February 1942 to June 1945 Inclusive.
6. Paratyphoid, Total Army, Continental United States and Theaters of Operations, U. S. Army, Cases and rates per 1000 strength per annum, January 1942 to June 1945, Inclusive.



## EPIDEMIOLOGIC CASE REPORTS

1. Typhoid Fever contracted from civilian sources .
2. Typhoid Fever infection originating during a period of absence without leave
3. Clinical Typhoid Fever in a faccinated individual.
4. Epidemic of Typhoid in Prisoner of War Enclosure.





A HISTORY OF PREVENTIVE MEDICINE  
IN THE  
EUROPEAN THEATER OF OPERATIONS  
UNITED STATES ARMY  
1941 - 1945

PART III - Epidemiology

Section 3 - Acute Respiratory Infections

Number 1 - Common Upper Respiratory Infection

by

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## PART III

### Epidemiology

#### Section 3 - Acute Respiratory Infection

##### Number 1 - Common Upper Respiratory Infection

Under most circumstances and in most parts of the world the work of the day in epidemiology rests with the acute infections of the respiratory tract. From time to time an epidemic of some other communicable disease may dominate all considerations. Special circumstances may bring another group of infections into particular prominence, or the nature of the environment may demand sustained effort on a problem like malaria. But ordinarily the respiratory infections account for greater numbers of infected individuals than do any other form of communicable disease. The epidemic potential of influenza can rival that of the five classical quarantinable diseases, which in general cause the epidemics of the world. The death rate for the respiratory infections ranks well up among those from acute infectious disease of all forms; and from the standpoint of disability, in days lost from illness, in non-effectiveness of troops, this group is the leading consideration.

In the European Theater of Operations the respiratory diseases were easily the most numerous among the acute infections; 63 percent were of this nature. About 30 percent of all reported disease of whatever cause, infectious or non-infectious, fell within this category.

The attack rate for respiratory infections of all forms, over the four years American troops were stationed in Europe was 165 per thousand per annum. This was not far from anticipated experience as determined by usual civilian standards for the age group involved, and by the rates which have endured for other armies in other wars. The death rate was materially less than anticipated.

The average mortality per thousand strength per annum was 0.04, which is an enviable record in comparison with that of the American Army in France in 1918, when the rate was 9.75 per thousand per year. It was also a satisfactory record in relation to similar rates for American troops in continental United States during the current war, or by almost any other standard that might be selected. The principal reason for this favorable experience was the absence of any significant epidemic of respiratory disease during the entire course of operations. The single event of any moment was the outbreak of Type A influenza that occurred in the



United Kingdom during the autumn months of 1943. In the number of deaths it caused, and in the number of persons who were ill, it offered scant comparison with the pandemic of 1918 which was the major medical event of World War I.

A new interest, not previously associated with military practice in other wars, came through the development of knowledge about primary atypical pneumonia, etiology unknown. The condition was easily the most important in the European Theater among respiratory infections. In attack rates it outdistanced primary lobar pneumonia to such an extent that reported deaths approached in numbers those from the pneumonias of all other forms, despite primary atypical pneumonia being notably a disease associated with low case fatality.

Classification of the Respiratory Diseases.--The nomenclature of the acute respiratory infections is in almost as confused a state as that of the intestinal diseases. Again the classification employed by the Statistical Health Report will be followed. All acute infections of the upper respiratory tract to include the common cold, acute catarrhal bronchitis, acute coryza, acute catarrhal pharyngitis, acute catarrhal nasopharyngitis, and acute catarrhal laryngitis are therefor grouped in these analyses under the general term of the common respiratory infections. Influenza will not be treated separately as its epidemiologic and etiologic identity might seemingly warrant. Due to the confusion and lack of definiteness which arises in the clinical diagnosis of that condition in non-epidemic times, and the tendency to call everything influenza when an epidemic does prevail, it will in all instances be considered and included with the common respiratory diseases. The only separate statistical consideration given influenza will consist of a simple demonstration of the number of cases reported by years.

The pneumonias will be considered under three categories: primary pneumonia, primary atypical pneumonia, etiology unknown, and secondary pneumonia. Primary pneumonia will be understood to include all pneumonias occurring in association with common respiratory diseases but will not include pneumonia secondary to influenza or to measles. Secondary pneumonia will include the pneumonias occurring with or as a complication of other diseases except common respiratory disease, as for example the pneumonias after influenza or measles. The term will also include post-operative pneumonias and pneumonias due to inhalation of chemicals. Primary atypical pneumonia, etiology unknown, will be shown as a separate entity. The pneumonias when spoken of collectively will be understood to include all three of the above categories.

If considered singly, the specific form will be designated. Total respiratory disease refers to all of the stated five divisions of this group of infections, the pneumonias, influenza and common respiratory disease.

Incidence of Total Respiratory Disease.--Troops in the field have repeatedly been shown to have more favorable rates for the respiratory diseases than when engaged in training with a more or less protected life in camps and barracks. The contrast is often as great as that between recruits and more seasoned troops, which likewise is a noteworthy feature of military experience in respect to the respiratory diseases.

During the first year of the European Theater, Table 1, the average rate for all respiratory diseases, 303 per thousand per annum, was a thoroughly satisfactory experience, taking into consideration that most of the men were newly arrived in a country having a climate that differed appreciably from that to which they were accustomed. Living conditions were often makeshift, and unit provisions and equipment which conduced to satisfactory management of the respiratory infections were often lacking. (Figure 1)

The rate of 421 per thousand for 1943, the highest for any of the four separate years of the European theater, reflects the effect of the extensive outbreak of influenza in the latter part of that year. The outbreak failed to carry over into 1944, which was indeed the most favorable of any within the experience of American troops in Britain. The Army moved to the European continent in June and operations there saw the best record for respiratory diseases of any second half year of the theater. In spite of a rugged winter campaign, the respiratory rate for 1944 was especially good, with only 151 men per thousand affected.

This very satisfactory experience was maintained in 1945, when for the first six months only 124 men per thousand contracted acute infections of the respiratory tract.

Deaths from Respiratory Disease.--The total number of deaths from all respiratory infections numbered 141. (Table 2) The average annual rate of 0.04 was very good, in comparison with the 9.75 per thousand for troops of the American Army serving in France during the last war. As a rate in itself, it constitutes a first class record, with due allowance for the favorable age group involved. Only 9 percent of deaths in the European theater from disease of all forms were due to respiratory infections. Among infectious diseases, the proportion was 31 percent.



Common Respiratory Diseases, Including Influenza.--The common upper respiratory diseases, particularly the common cold, are characterized in north temperate regions by two general waves of incidence. The first ordinarily makes its appearance in September and the second in February. This pattern was rather well met in the four years of the European war, except that the autumn wave of 1944 was somewhat delayed and the winter wave in all four years tended to appear rather earlier than February, January invariably marking the month of greatest incidence for these infections. (Table 3) Since the great bulk of respiratory disease is made up of the common simple acute upper respiratory infections, the behavior of these diseases by years was in close accord with that for respiratory diseases as a whole. The year 1942 was an ordinary year with an annual rate of 291, and the usual seasonal distribution. The best record was attained in 1945, while 1943 had the highest rate because of the epidemic of influenza that occurred during the autumn. The last two months of 1943 were heavily weighted by that outbreak. The number of reported cases in December 1943 was the greatest of any single month in this experience, while the months of November and the succeeding January of 1944 were characterized by a large excess of cases over normal expectancy. The rate during the height of the influenza outbreak, however, was actually not quite that of the preceding January, 1943.

The freedom from respiratory disease during the autumn of 1944 furnished a clear example of how well troops do in the field. The winter was relatively severe. The troops were engaged in a winter campaign, the first great winter campaign fought in western Europe, and the effects of the rigorous temperatures were evident in the undue frequency of cold injuries during that time. The December rate for common respiratory infections was nevertheless only 122, and the figure for the following January was no more than 166.

Racial Differences in Incidence.--The rates for acute infections of the upper respiratory tract including influenza were consistently lower for the colored component of the European forces than for white troops. This was true for troops stationed in the United Kingdom and for those serving on the continent. (Table 4) The ratio held during the course of the 1943 epidemic of influenza as it did during the periods when only common upper respiratory infections were prevalent. Indeed, the differences between attack rates for white and colored populations were more pronounced during the outbreak of influenza than during ordinary times.





Figure 1.

Nissen huts used for quarters at Fugglestone Camp,  
United Kingdom, 1942.



Common Respiratory Infections in Major Components of the European Forces.--The period of active operations in Europe, from June 1944 to June 1945, was particularly favorable in respect to the common respiratory infections. In fact, no similar period in the history of the theater showed to better advantage. A significant feature was related to the difference in rates for common respiratory disease shown by troops stationed in Great Britain, compared with those operating on the continent. The level of acute upper respiratory infection in the United Kingdom did not depart greatly from previous experience, although by comparison with other years in the United Kingdom it would be termed a good year. The principal contribution to the very favorable rate of the final year of the war came from the troops serving on the continent. (Figure 2, Table 5) This held true for all three major components of the forces of the theater. Of troops stationed on the continent, only those of the Ground Force Replacement Center had rates for respiratory diseases that compared with those of the troops then stationed in the United Kingdom.

Of the three principal components of the army, the Communications Zone, the Air Forces, and the Ground Forces, soldiers of the Communications Zone consistently showed the highest rates, both on the continent and in the United Kingdom; but the record for continental Communications Zone forces was measurable better than for troops of the service stationed in Great Britain. (Figure 4, Section 3, Number 2) This was likewise true for the Air Forces in the two localities. (Figure 3, Table 6) No worthwhile comparison can be made for Ground Forces because the number of troops of the line in the British Isles was decidedly limited and rapidly changing, since the United Kingdom base served principally as a staging area and also in the latter parts of the campaign most troops came directly to the continent from the Zone of the Interior.

During the period of continental service, the Ground Forces had far and away the most favorable rates for common respiratory infection, the Ground Force Replacement Center being considered an independent command. (Figure 4, Table 7) In order of greatest morbidity from acute upper respiratory disease, the three services ranked in the order of Communications Zone, Air Forces and Ground Forces.

This same relative position had characterized the preceding year in Great Britain, when rates for common respiratory disease were at a high level due to the then current outbreak of influenza. (Figure 4, Section 3, Number 2) Throughout the entire course of operations, the highest rates for respiratory disease were generally to be found among Communications Zone units, with the Air Force and Ground Forces showing no great differences in



respect to each other, but both ordinarily more favorably placed than the Services of Supply.

Acute Upper Respiratory Infection Among Field Armies.--The 15th United States Army became operational only during the late phases of the European campaign. Its record from the last week in February until the end of hostilities was excellent, although the unit did not participate in operations and was not subjected to the same rigorous field conditions under which the other armies of the United States forces operated.

No great difference existed between weekly rates (Figure 5, Table 8) for the First and Third Armies, although the full record of the First Army is slightly better. The average incidence of common respiratory infection in the Seventh Army was somewhat greater than that of the first two named, but not significantly so. The Ninth Army had decidedly the best rates of any of the four active armies in the field. It is to be noted that all four experienced sharply rising and equally rapidly falling peaks of incidence during the first week in February of 1945, that of the Seventh Army being the most pronounced and that for the Ninth least well marked, while the epidemic wave was longest maintained in the First Army.

Comparison with United States Domestic Forces.--During two of the four years of the war period, 1944 and 1945, the annual rates for common respiratory disease, including influenza, were better in the European Theater than for troops of the United States Army serving in continental United States. For the first two years of military operations, domestic troops had the better rates particularly in the 1943 influenza year, although it is to be recalled that influenza also existed in the United States at that time. (Figure 6, Table 9) The rate for the four-year period was 204 per thousand per annum for troops of the Zone of the Interior and 155 for those serving in the European Theater. The difference was not great and constituted a commendable record for any army operating in the field under climatic conditions not particularly conducive to favorable rates for respiratory disease. Actually the best comparative showing by troops of the European Theater came when field operations in France were at their height. (Figure 7)

Comparison with Other Theaters.--Average rates for the full period of military operations until 1 July 1945 showed the European Theater to occupy a middle position in relation to other theaters of operation. The overall rate of 155 per thousand per annum in Europe was exceeded by the Africa-Middle East Theater and North American, by the China-Burma-India Theater, and the Alaskan.

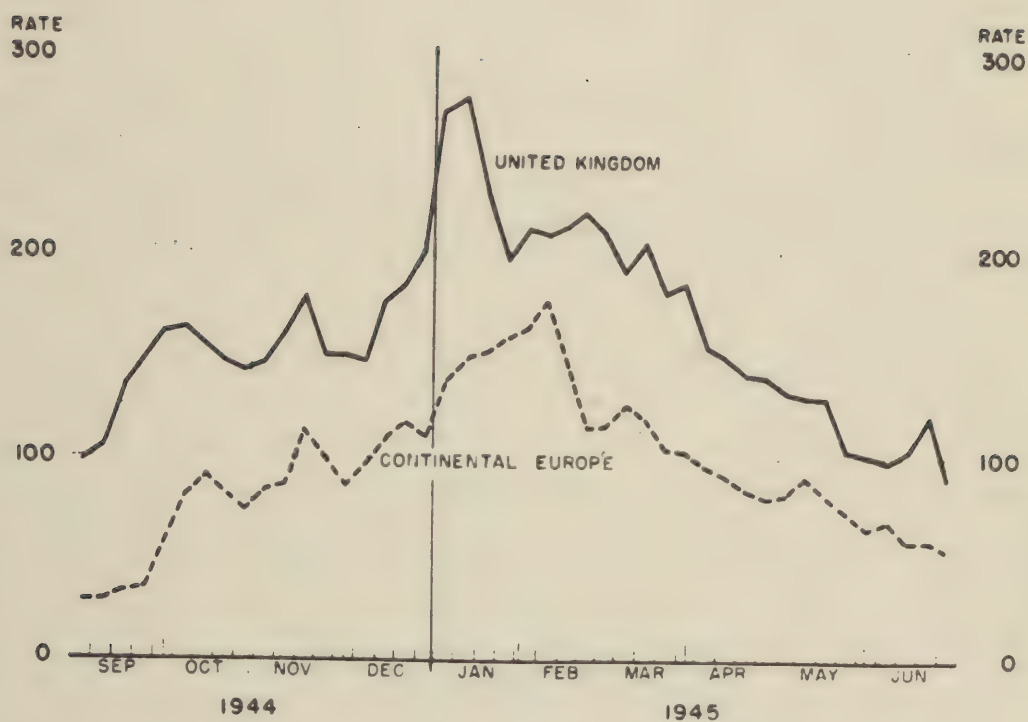


Figure 2.

Common respiratory diseases including influenza, United Kingdom and Continental Europe, European Theater of Operations, U. S. Army, admission rates per 1000 strength per annum by weeks, 1 September 1944 to 29 June 1945 inclusive.





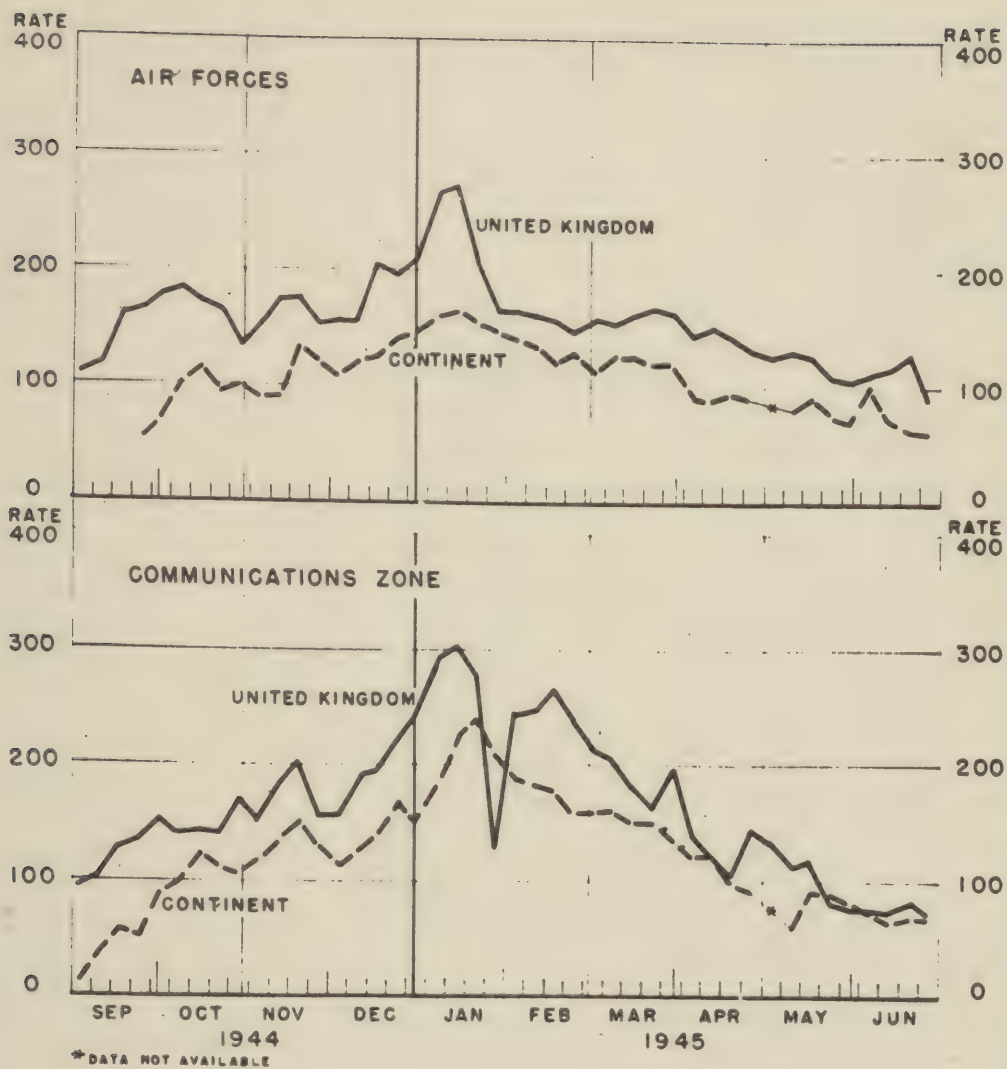


Figure 3.

Common respiratory diseases including influenza, Air Forces and Communications Zone, United Kingdom and Continental Europe, European Theater of Operations, U. S. Army, admission rates per 1000 strength per annum, by weeks, 1 September 1944 to 29 June 1945 inclusive.



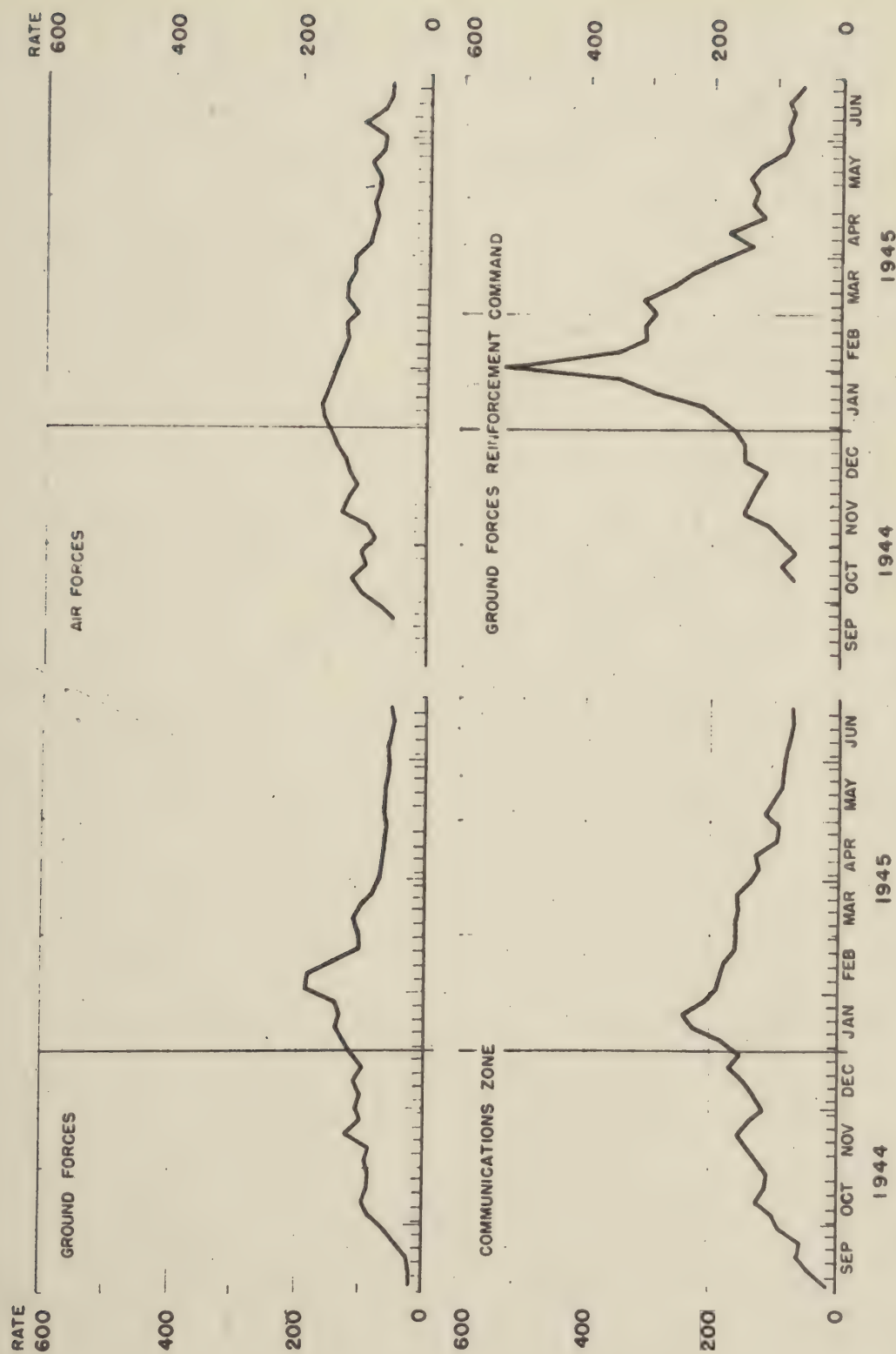


Figure 4. Common respiratory diseases including influenza, by major components on the continent, European Theater of Operations, U. S. Army, admission rate per 1000 strength per annum, by weeks, 1 September 1944 to 29 June 1945 inclusive.





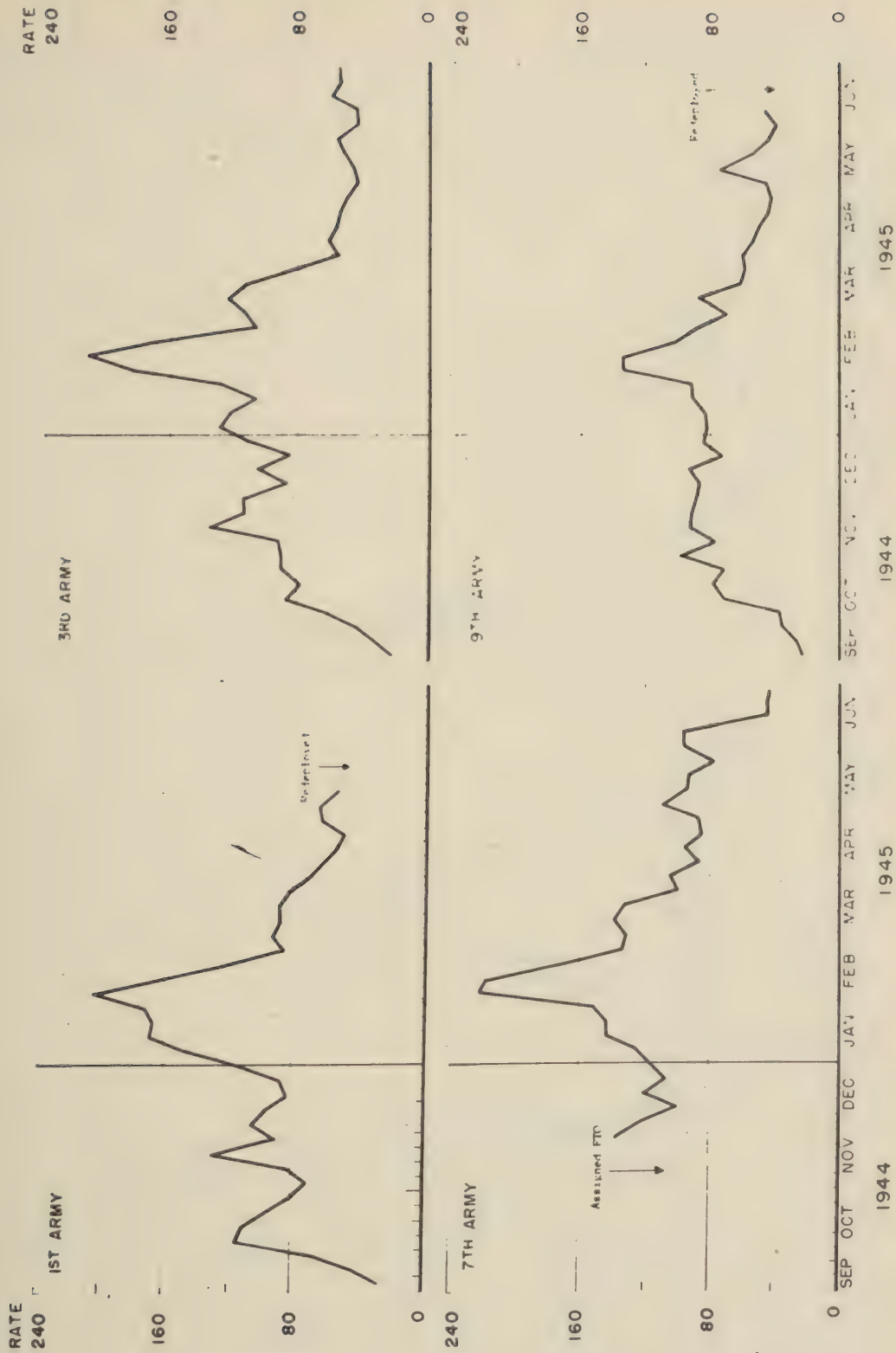


Figure 5. Common respiratory diseases including influenza, by armies, European Theater of Operations, U. S. Army, admission rate per 1000 strength per annum by weeks, 16 September 1944 to 29 June 1945 inclusive.





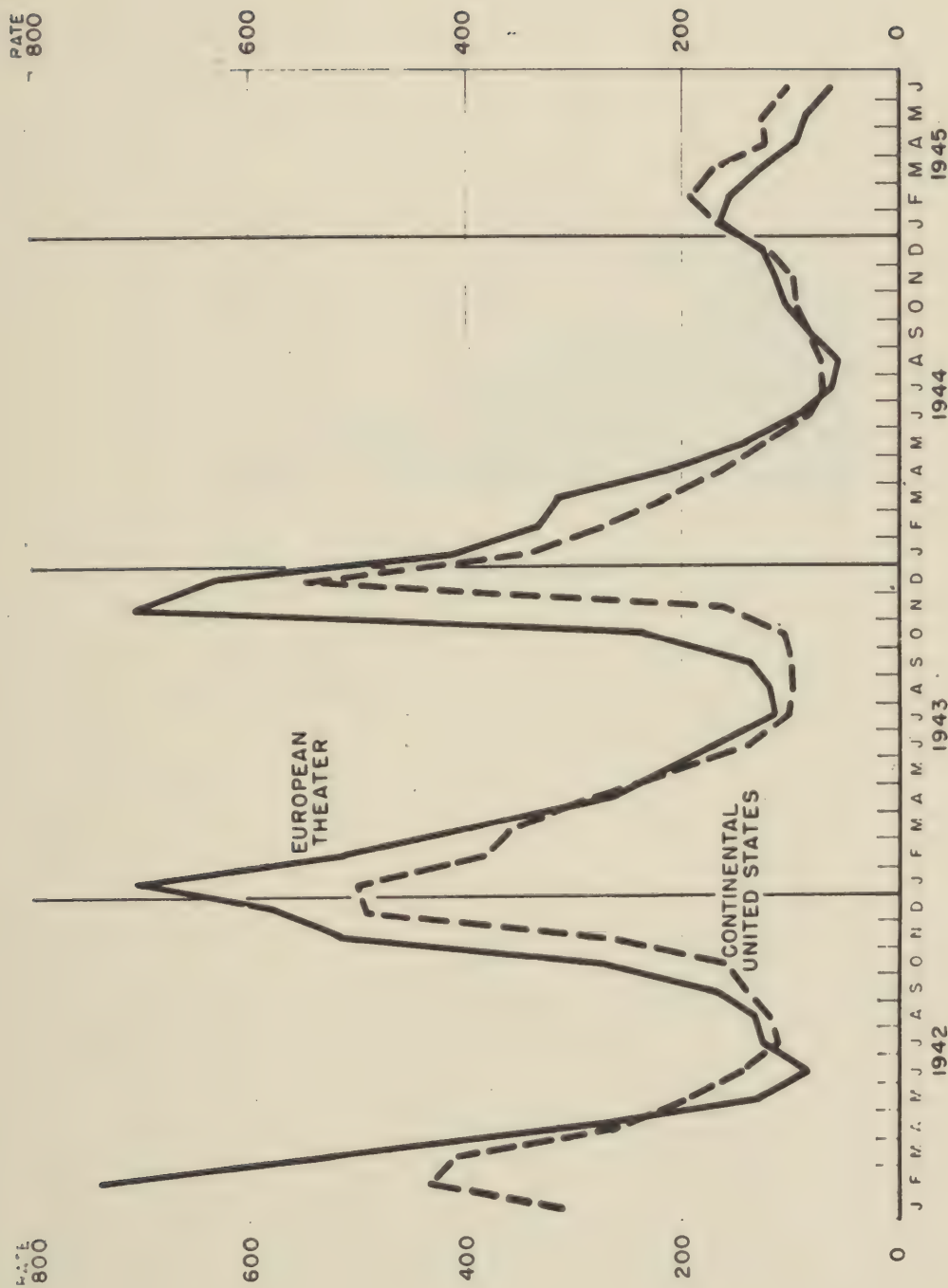


Figure b. Common respiratory diseases including influenza, Continental United States and European Theater of Operations, U. S. Army, admission rate per 1000 strength per annum, by month, January 1942 to June 1945 inclusive.





Figure 7

Winter quarters of the 394th Infantry Service Company,  
99th Infantry Division, Sourbrodt, Germany, January 1945.





The Southwest Pacific Area, Pacific Ocean Area, Mediterranean, and Latin American Theaters had better rates. (Table 10)

The best position ever attained by the European Theater among other theaters of operation was fourth in 1944 and 1945, and the most unfavorable comparative standing was in 1942 and 1943 when the rates in Europe were the highest among the nine theaters.

Common Respiratory Infections Among Army Troops on Transports.--From the time that troop movements to the United Kingdom began in early 1942, voyage reports of transport surgeons gave account of a high incidence of acute upper respiratory disease among troops in transit from the Zone of the Interior. Appreciable outbreaks occurred, sometimes on board ship and sometimes shortly after arrival. The condition became so common that it was popularly termed a ship cold.

These simple infections of themselves had a certain significance, in that they interfered with training after the troops arrived and led to an appreciable amount of non-effectiveness. Their principal importance was as an index of the possibility of more serious infections from the same source, such as characterized the movement of troops in the last war. Numerous and rather serious epidemics of pneumonia and meningitis occurred at that time among troops in transit to Europe.

An epidemiologic survey of three groups of nurses recently arrived in the theater, was made early September 1942. They had travelled on separate ships of the same convoy and were stationed in the same staging area after arrival. The survey included the period from 1 August 1942 to 5 September 1942, corresponding to four days prior to embarkation, the period of travel, and the subsequent three weeks after arrival in the theater staging area. Individual case histories were obtained in respect of the presence or absence of an upper respiratory infection and of the nature of the attack. Of 151 nurses interviewed, 111 reported upper respiratory infection during the survey period. (Table 11)

The attack rate was exceptionally great, 74 percent. The behavior of the outbreaks that involved the three groups was essentially identical, although the nurses travelled on different ships. Essentially the same proportion of individuals were involved and the spread of the infection followed the same pattern. (Figure 8, Table 12) Only two nurses contracted upper respiratory infection during the five-day period preceding embarkation. No similar five-day period approached this low number until one week

after arrival in the staging area. The outbreak reached a peak toward the end of the travel period and fell off rapidly after arrival at the staging area. The effects of the infection were relatively long continued, more than half lasting longer than 14 days.

This preliminary study of shipboard colds was extended to include 592 men of the 16th Medical Regiment (exclusive of 26 officers) and 238 men of the 28th Signal Battalion. Similar study methods were used. All individuals of the survey group were interviewed and their colds divided by date of onset into the three main divisions of the survey period. These were a preembarkation interval, Period A, corresponding to the last three weeks in the United States prior to embarkation; the time in transit, Period B, extending from the date of embarkation to the date of arrival at their station in England, inclusive; and the period after arrival, Period C, which was 20 days in the first instance and 17 days in the second, since the latter survey was made 17 days after arrival.

Before departure for the European Theater, the 16th Medical Regiment had been stationed for several months at Camp Devens, Massachusetts. Leaving there, the unit embarked directly without intermediate stops at temporary staging areas. The men crossed in a single ship, and although subjected to the usual conditions of overcrowding, all were accommodated below deck. They travelled in the same convoy as the units of nurses included in the preliminary study although on different ships, embarking on 5 August 1943, landing on 17 August and reaching their station in England on 18 August. Subsequent to arrival in England they were reinforced with an additional 55 men who were included in the study group. These men crossed in another ship of the same convoy, 35 sleeping inside and 15 on deck, with no information available for the other five. They originated from Camp Grant, Illinois, and spent three days in Fort Hamilton, New York, prior to embarkation.

The 28th Signal Battalion reached England after the 16th Medical Regiment. Before sailing on 31 August, they had spent five to six weeks at Fort Dix, New Jersey. Their crossing was on a fast ship sailing without convoy. They landed on 5 September and proceeded to their assigned station in England on the following day.

The incidence of colds in Periods A, B, and C is shown in Table 13, for each unit. The crude rates illustrated are not comparable, since they take into account neither the varying length of the different periods nor the factor of susceptibility. Knowledge of the immunologic mechanism involved in colds is too meager to justify or attempt to postulate a period of immunity following



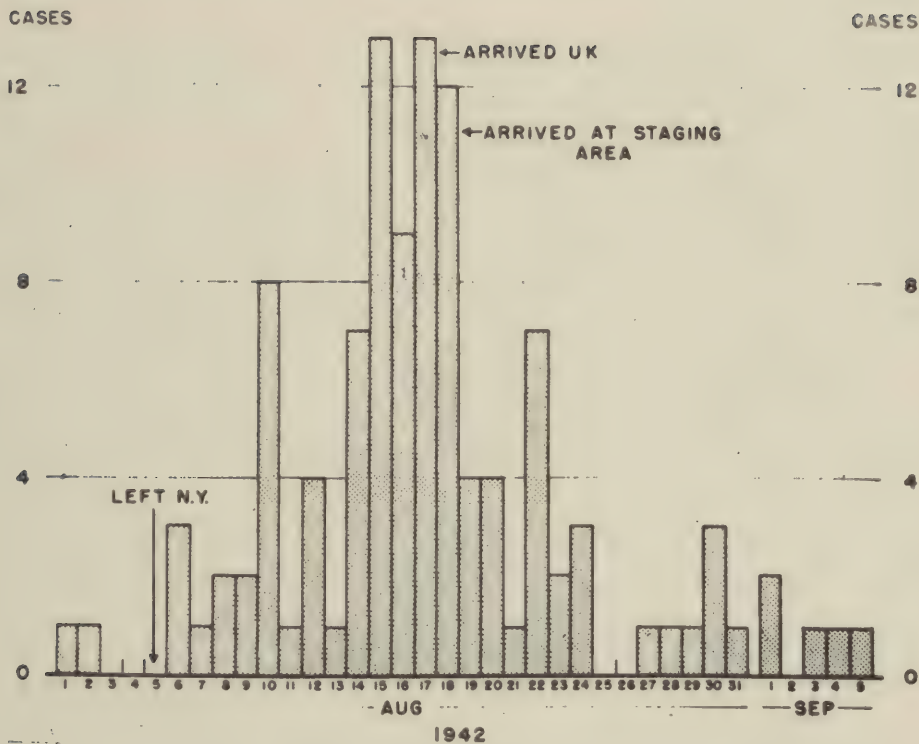


Figure 8.

Upper respiratory infection among 151 nurses in transit from Zone of Interior to European Theater of Operation, by date of onset, August-September 1942.



injection, but it is evident that an individual suffering from a cold cannot contract a subsequent cold that he will recognize as such, until he recovers from the one that he has. During the course of a cold, therefore, a person was not considered as part of the population at risk, and was placed temporarily in the category of non-susceptibles. Since approximately half the colds in these two survey groups had a duration of over three weeks, this consideration was of major importance.

To correct for these factors, the total exposure of each group in each of the three periods was reexpressed in terms of person days. Each cold was then considered individually, and when it extended into two or more periods it was divided into individual components falling within each time stage. The total duration of colds in person days for each period thus represented person days of non-susceptibility. When each such total was subtracted from the corresponding total exposure previously computed, the remainder represented the total exposure of susceptibles for the period. As the population at risk was expressed in terms of person days, the resulting rates were daily incidence rates and therefore comparable. For purposes of comparison, the findings of the preliminary survey of nursing units were included with the subsequent examinations. Table 14 gives the corrected daily rate for the three groups. It will be seen that the three sets of rates were similar for periods A and B, but that in C the incidence dropped sharply in the first two groups, while continuing to rise in the third. The latter difference in respect to the Signal Corps group between Periods B and C is not significant, (1.7 times its standard deviation) but the decreasing rates for the first two units do show a statistically significant difference between B and C.

The 26 officers of the 16th Medical Regiment were not included in the tabulations, in that they were not subjected to the same environmental conditions on board ship. There were 15 colds among this group, two in period A, nine in B, and four in C, giving corrected daily rates of 0.4 percent, 2.7 percent and 1.3 percent respectively. Comparisons of the 55 men from Camp Grant with the 537 from Camp Devens, and of the 35 Camp Grant men sleeping inside with the 15 sleeping on deck, showed a higher but not significantly higher incidence of colds from Camp Grant and for those sleeping on deck.

The dates of onset were seldom given as actual dates, but usually in some such form as "a few days after sailing," "half way across on the boat," or "a week before we sailed." The basic data did not justify presenting an actual day by day



incidence. For this reason, the times of onset were grouped into subdivisions of one week in period A; two and three days in B; and three and four days immediately after arrival and one week in C. The various groupings of the numbers of colds originating within each of the two organizations were arranged in Table 15 and shown graphically in Figures 9 and 10. Since the bars of the two graphs are of varying width, the incidence is of necessity expressed in the forms of average daily number of colds. The two curves appeared to be roughly similar but that of Figure 9 showed a much greater part of the curve in period C.

Table 16 presents an attempt to classify the severity of 117 colds in the 16th Medical Regiment and all in the 28th Signal Battalion. The relative distribution of mild, moderate and severe colds in each period appeared to be similar. Very few patients were sent to hospital, although a good many others said they would have liked to have been. Of the two later survey groups, only 15 were confined to bed in hospital, dispensary or quarters for periods ranging from one to nine days and for a total of 49 days.

The duration of colds for the two survey groups is shown in Table 17. Only about one-third of the colds in the 28th Signal Battalion could be classified, as the remainder were still in progress at the time of the survey, with onset less than three weeks before. Approximately one-half of the colds of known duration lasted longer than three weeks, which probably accounts at least in part for the relatively small number of men with more than one cold (17 had two colds and two had three) during the survey period.

The two units differed chiefly in branch of service, size of survey groups, date of embarkation, length of voyage and addition of personnel after arrival. The first was a Medical Regiment of 592 men sailing on 5 August 1943, crossing in 12 days and with 55 of their number added after reaching their station in the theater. The other was a Signal Construction Battalion of 238 men (the strengths of both units are in terms of individual surveys), sailing on 31 August, crossing in 5 days and with no additions after arrival in England. Differences in station, both in the United States and in England may well have been important factors but evaluation was beyond the aims of this simple survey. Both units were quartered in apparently satisfactory billets.

The rate of incidence for colds in both groups was extremely low prior to embarkation, and greatly increased during the period of travel. July and August on the eastern seaboard of the United States are months with relatively few respiratory

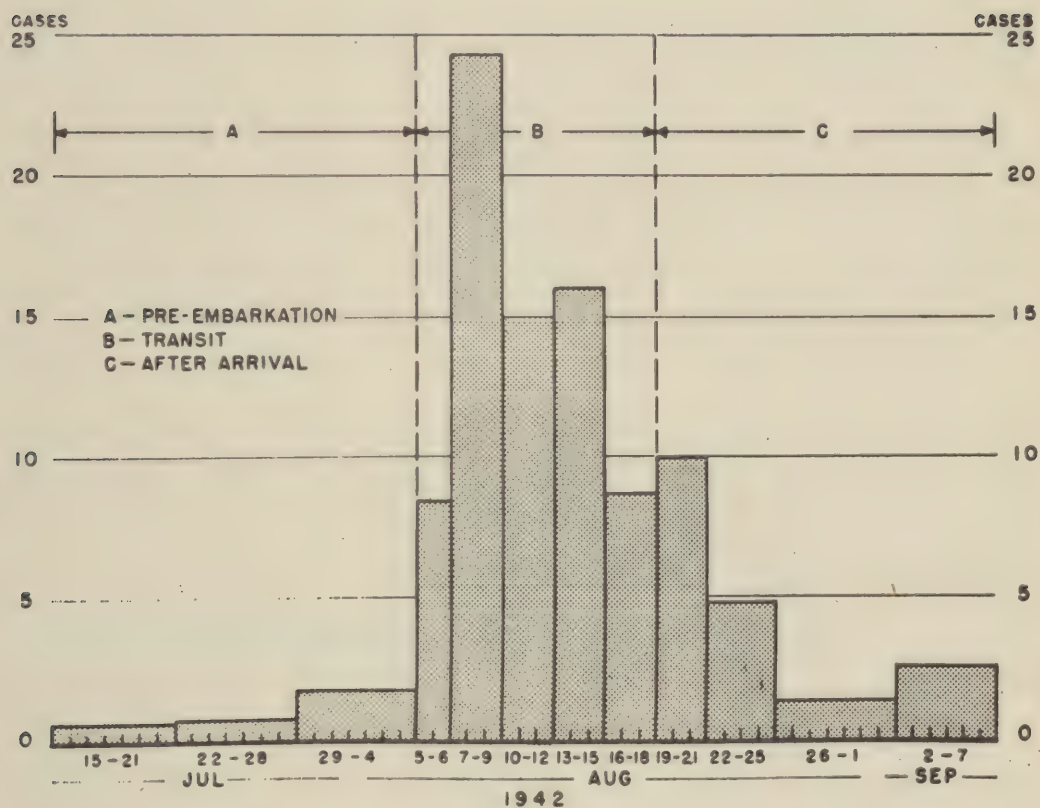


Figure 9.

Upper respiratory infections, 16th Medical Regiment, U.S. Army Transport, average number of cases for periods indicated, by dates of onset, July to September 1942.





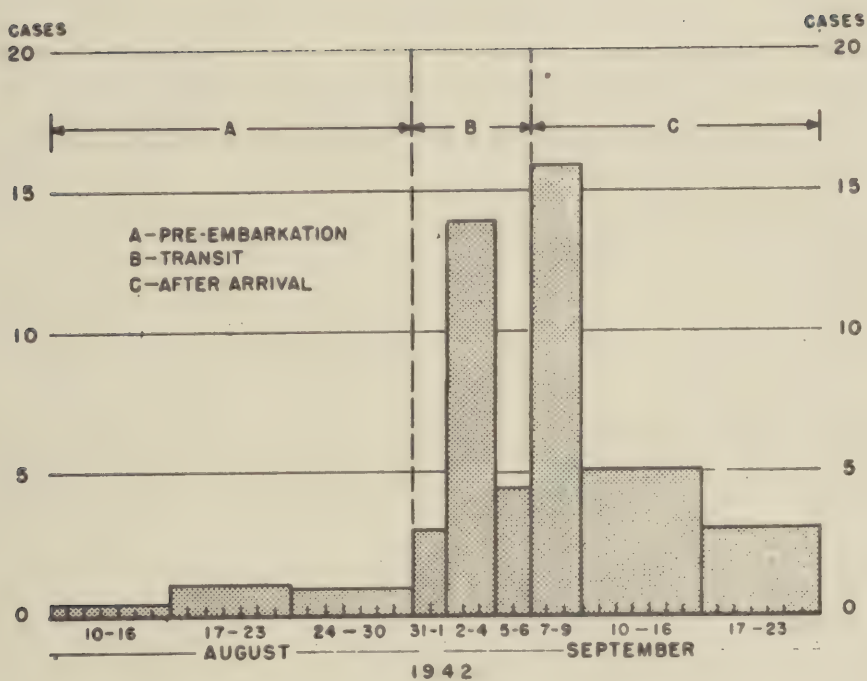


Figure 10.

Upper respiratory infections, 28th Signal Battalion, U.S. Army Transport, average number of cases for periods indicated by dates of onset, August to September 1942.



infections, while on shipboard the men were suddenly exposed to unfavorable climatic conditions plus the heavy exposure to infection associated with overcrowding. During the two to three-week period after arrival, the rate for the Medical Regiment dropped sharply, although still maintained well above its pre-embarkation level, while that of the Signal Battalion remained elevated. The curves of incidence (Figures 9 and 10) provide a reasonable explanation. Both curves started to rise at the time of embarkation, reached their peak fairly rapidly, and then subsided more slowly to reach a new and somewhat higher base line, approximately three weeks later. The brief drop for the Signal Battalion on 5 and 6 September is the only major difference and might represent either the interval preceding a superimposed secondary wave or a statistical artefact caused by onset dates not being accurate to the day. Otherwise the general appearance and extent of the two curves was much the same and what would be expected as the result of a sudden and large scale herd aggregation. The explanation of the difference in incidence rates in period C would therefore appear to be due to the extremely fast crossing of the ship carrying the Signal Battalion which brought about the intrusion of a considerable portion of the epidemic curve in period C that would have fallen in period B had the crossing been more leisurely.

As a result of these studies representations were made to The Surgeon General by the Chief Surgeon of the European Theater expressing the opinion that the attack rates from upper respiratory infection among troops on transports were sufficiently great to exert a significant effect on physical condition, training, and general effectiveness for a measurable period of time. It was brought out that overcrowding was a major cause of the situation. (Figure 11) Recently advanced methods for the control of respiratory infections such as the use of aerosols, oiling of floors and blankets, and similar procedures had not been investigated in respect to transports. Existing facilities for washing mess kits aboard ship had been found with few exceptions to be bad. It was suggested that certain administrative factors might play a part, such as alternate nights of sleeping on deck and in cabins.

The interest of the Surgeon of the New York Port of Embarkation was elicited through action by The Surgeon General. This in turn led to the appointment of a committee to investigate and evaluate the problem of acute upper respiratory infection among troops on transports, with a view of improved measures of control.



The subsequent introduction by the Army Transport Service of administrative changes in methods of dispatching troops to foreign theaters led to greatly improved conditions. A committee originating from the Board for the Control of Influenza and other Epidemic Diseases in the Army made a comprehensive study of the situation and instituted investigative studies designed to improve methods of prevention on transports.

Control of Common Respiratory Infections.—The principal reliance in control of the acute infections of the upper respiratory tract as they occurred among troops of the theater was of necessity placed on the general measures entering into personal and community hygiene. No specific preventive measure of demonstrated value was available, except in respect to influenza; and that not until late in the final year of operations when the absence of that particular infection obviated its use.

Administrative Measures.—Continued stress was placed on the responsibility of unit commanders for the enforcement of all disease preventive measures within their respective commands, a responsibility which could not be delegated to subordinates. To aid in the proper discharge of this duty, the technical measures concerned with the control of respiratory infections were incorporated in directives issued by various organizations of the theater at different levels of command. Those of the theater were ordinarily general in nature; those of base sections of air forces and of armies gave greater detail. Specific information relating to personal hygiene, to control of the environment, and to the application of special control measures was made available to unit surgeons through the activity of officers in Divisions of Preventive Medicine, in the course of routine visits or by special conference when the frequency of infections of the respiratory tract became a matter of particular concern to a given unit.

Personal Hygiene.—In the training of the individual soldier emphasis was placed on available means to avoid as far as practicable the infective agents of acute respiratory infection and on the methods for limiting their transmission to others. The features of personal hygiene especially stressed by unit commanders and medical officers included the importance of avoiding contact with patients who had common colds or other forms of acute upper respiratory infection; the proper methods for disposal of sputum and nasal secretions, with stress on the dangers of promiscuous spitting; the importance of covering the nose and mouth with a handkerchief when coughing or sneezing; the dangers of common drinking cups, canteens, towels and other personal items, and of passing cigarettes and pipes from one man to another. The importance of personal cleanliness, of thorough



Figure 11.

A small section of one compartment aboard a U. S. Army transport after loading at the New York Port of Embarkation, 1944.







Figure 12.

U. S. soldiers introduce a Halloween Ball to English girls,  
England, October 1942.



hand washing, of frequent changes to clean fresh clothing; and the dangers of unnecessary crowding of individuals in poorly ventilated, closed places were other matters that received attention. (Figure 12)

The physical welfare of the individual enlisted man was to be given particular attention in regard to the prevention of excessive fatigue and chilling; the prescribing of apparel in keeping with the weather conditions encountered; and with specific prohibition against patronizing eating and drinking establishments outside the military reservation not approved for military personnel.

In times of excess incidence of respiratory infections officers directed more than usual attention to the maintenance of a proper diet for the command, through maximum utilization of the prescribed ration and with particular emphasis on foods which provided vitamins A and C, such as lemon crystals, fruit and tomato juices, leafy, green and yellow vegetables, milk and cheese, and dehydrated eggs. Protein foods such as meat, fish, eggs and fat were advised as contributing to body warmth. Soldiers going on trips and passes were urged to consume the emergency rations provided. Although these rations may not have been particularly palatable, they furnished important heat and nutritive elements.

Environmental Measures.--With the aim of reducing to a minimum the transmission of respiratory disease within organizations, constant supervision and inspection was required to prevent overcrowding in barracks, mess halls, class rooms, offices and similar places; to maintain the prescribed air space per individual in barrack buildings; and to assure proper ventilation of barracks during sleeping hours. Strict adherence of head to foot sleeping arrangements was demanded in times of epidemic prevalence, together with utilization to the fullest possible extent of cubicles improvised from shelter halves, where an excessive degree of overcrowding was unavoidable.

The relative importance of dust in the transmission of respiratory disease has received increasing attention in recent years. Irrespective of whether or not oiling of floors was practiced, dry sweeping was avoided and the necessity for thorough scrubbing of floors with hot, soapy water at frequent intervals was stressed.

Since poor mess management and insanitary mess equipment contribute so pertinently to the spread of respiratory infection, all messes were required to be closely supervised, and inspections made with particular diligence in times of excess



incidence of acute respiratory disease. Attention was directed toward careful and frequent examination of food handlers for evidence of respiratory infection, with recommendation that they be promptly removed from duty for report to the unit surgeon. Proper cleansing and sterilization of dishes and mess equipment, and thorough washing of tables and condiment containers with hot soapy water were other ordinary features that required particular attention in times of epidemic respiratory disease.

Officers charged with the operation of service clubs, post exchanges and theaters were held responsible for the observance of such of the outlined disease preventive measures as applied. In the case of post theaters, only the specified seating capacity was to be permitted and a sufficient interval allowed between shows to permit thorough airing of the auditorium.

Blackout requirements often interfered with proper ventilation. Fuel supplies in the European Theater were rarely plentiful and this led to the common practice of blocking up ventilators. Frequent inspection of quarters was necessary to insure that proper ventilation was provided, particularly during sleeping hours. Proper humidity of sleeping quarters was aided by keeping cans of water on stoves during the hours when heat was authorized. Barracks were directed to be thoroughly aired during the day.

One of the most important of the general provisions for control of respiratory disease related to the provision of adequate facilities for drying clothes. All units were directed to maintain the special drying room provided for in army regulations, on a scale of one square foot per man. Well heated tents served the purpose with field units. For field troops, this measure ranks well up on any priority list of preventive measures.

Medical Measures.--Physical inspection of incoming troops, whether by train, motor transport or by marching was especially necessary in time of epidemic. New additions to a force spell trouble. Prompt segregation of all patients with acute infections was accomplished before new troops were assigned to quarters. Detention areas were directed for all units where the influx of new personnel was great, with incoming troops quartered in these detention areas and not permitted to mingle with personnel of the station until all possible sources of infection had been eliminated by proper segregation and hospitalization of infected individuals.

If the fullest measures were not taken to insure proper isolation of patients admitted to dispensaries and infirmaries, other patients were subjected to the possibility of contracting a respiratory cross infection not present when they were admitted. Care was taken that all discharges from patients in infirmaries with respiratory or other communicable disease were burned or otherwise disinfected.

Unit and dispensary surgeons were expected to maintain a position of properly advising commanding officers regarding the prevention of respiratory disease. Intensification of the activities of medical inspection and of screening out of infected individuals was essential. Prompt removal of infected individuals was recommended as of the greatest aid in the control and prevention of spread of respiratory infection. Officers and enlisted men with acute catarrhal symptoms accompanied by a temperature one degree or more above normal should be promptly hospitalized. There was furthermore an increasing realization that a day or two spent in taking care of a cold in the beginning usually saved several days of non-effectiveness. Informal reports concerning infractions of regulations were advantageously rendered to the commander of the organization concerned, with recommendations for correction. Follow-up inspections were found to be important.

Working quarantine was not considered a practical measure for the control of acute upper respiratory infection. There was no method of determining carriers and from the standpoint of the results likely to be obtained, quarantine on any effective scale interfered too greatly with unit activities.

Special Measures.--Three recently developed measures were used in varying extent by units of the theater, principally on an experimental basis. These included the oiling of floors and blankets, the use of sulfadiazine as a chemoprophylactic agent, and the attempted control of the atmosphere within barracks and buildings by the use of aerosols, principally propylene glycol. More general use was made of the first of these measures because of its simplicity and because the method had been popularized by British workers. Chemoprophylaxis by sulfadiazine was limited essentially to a major trial by the Air Forces, and a smaller study in a General Hospital. Aerosols were used experimentally in one Air Force station.

Oiling of Floors and Blankets.--A comprehensive, thoroughly controlled test of the efficacy of oiling floors and blankets was contributed by the medical staff of the Eighth Air Force. The method was used fairly extensively by a number of units of that organization



and by several representative installations of the Communications Zone. The general opinion as to its usefulness was favorable. It had the advantage of simplicity, and through use of spindle oil was not expensive. It appeared to be a worthwhile addition to the general program of prevention of these diseases.

Aerosols in the Control of Respiratory Infection.--The opinion of the Army Epidemiologic Board that technical methods concerned with the use of aerosols had not been developed to the point where wide scale use of the procedure was practical found substantiation in the experimental use of propylene glycol as an aerosol at one of the air force stations. Efforts to control the transmission of air borne disease by sterilizing the air in dwellings occupied by troops was abandoned because of the difficulties of producing a high enough concentration of propylene glycol to have a bactericidal effect. There was also difficulty in controlling humidity. It became evident on completion of this experiment that the method in the present state of its development was not feasible under field conditions even though units were essentially static.

Chemoprophylaxis of Respiratory Infections.--Recent investigations conducted by the Army Epidemiological Board, the headquarters of certain Service Commands in the Zone of the Interior and the office of the Air Surgeon, and by the United States Navy, indicated that the incidence of meningococcal meningitis and streptococcal sore throat, and of certain upper respiratory diseases of bacterial origin might be remarkably reduced by the prophylactic administration of small doses of sulfadiazine. A War Department Technical Bulletin gave indications, procedure, dosage and precautions to be employed in the administration of sulfadiazine prophylactically to large bodies of troops.

The method was authorized for use in overseas areas in the manner provided, when recommended by the theater commander. Considering that practically all of the military personnel in the European theater had had at least six months seasoning in the army, and that the prevalence of diseases transmitted through the respiratory tract and susceptible to sulfadiazine prophylaxis was extremely low, it was adopted as the policy of the theater that the method was to be used only when epidemiological, clinical and laboratory investigations performed on a sampling basis indicated that the disease or important complications occurring in an epidemic manner were due to beta hemolytic streptococci or to the meningococcus; or under conditions of a rapidly increasing incidence of respiratory infection to which affected individuals were not responding satisfactorily. In all instances prior to



initiating a program of sulfadiazine prophylaxis, the surgeon of the theater was to be notified and concurrence obtained.

Adequate opportunity for trial of the newly developed method was afforded by a large scale experiment introduced by the Air Force Service Command of the Eighth Air Force and subsequently extended to all Air Force troops of the theater.

The personnel of four stations of the Service Command were arbitrarily separated into two groups. Occupants of even numbered barracks formed group A, and occupants of odd numbered barracks constituted group B. Groups A and B from each station were combined to form the respective composite groups A and B referred to subsequently. The two groups A and B numbered approximately 6,000 men each.

Sulfadiazine was distributed by the barracks chief and actual ingestion was recorded daily by roster. Unannounced spot urine tests on approximately ten percent of the test group served as a further check of whether or not the drug was being taken. The percentage of individuals in the treated groups recorded as ingesting the drug varied around 77 percent.

Prophylactic sulfadiazine was administered first to one group, then to the other and terminally to both groups. During the first seven weeks of the experimental period, 8 October to 24 November 1944, group B received prophylactic sulfadiazine while group A served as the untreated control. During the first four weeks of the seven, 7 October to 3 November, each member of group B received 1 gram daily; for the remaining 3 weeks, 3 November to 24 November, the dose was reduced to 0.5 grams daily.

During the next nine weeks, 25 November to 26 January, the status of the groups was reversed, in that group A received the drug and group B served as the untreated control. Group A received 1.0 gram of sulfadiazine daily for the first week only, 25 November to 1 December, and thereafter 0.5 gram daily. During the next 9 weeks, 27 January to 30 March 1945, group A continued the treatment with group B also receiving prophylactic sulfadiazine. The men of both groups received 0.5 gram of sulfadiazine daily throughout this period. (Figure 13)

The general conclusion derived from these investigations was that common respiratory diseases were appreciably reduced by the use of prophylactic sulfadiazine. The effect was apparently even when the rate for respiratory disease was comparatively low

(100 to 150 per thousand strength per annum), and the effect was maintained for as long as 18 consecutive weeks. The maximum effect was obtained more quickly with a one gram daily dose than with a one half gram dose; the lowered rate once established was maintained equally well with either. A second course of prophylactic sulfadiazine seemed as efficacious as the initial course.

Toxic reactions to sulfadiazine were mild and infrequent. The majority occurred within the first four weeks of chemoprophylaxis and were dermatological in type. There was no conclusive evidence suggesting that one course of the drug sensitized to subsequent administration.

To obtain the maximum protective effect, a high percentage of personnel had to ingest the prescribed daily dose. This required clear forceful indoctrination of all personnel, especially of commanding officers and medical officers, both initially and at intervals throughout the period of observation; rigid supervision of administration; and constant vigilance to dispel false rumors of harmful effects of sulfadiazine. A satisfactory drug coverage consistently maintained the admission rate for respiratory diseases at less than one hundred. A certain periods this represented an 80 percent reduction in comparison with existing rates for the control group. Less adequate coverage gave proportionately poorer results. The protective effect of chemoprophylaxis adequately applied was appreciable even with admission rates of 150 to 200. In flying personnel with less adequate coverage, the removal rate was not significantly affected by chemoprophylaxis unless the annual rate exceeded 350 to 400. Prophylactic sulfadiazine not only reduced the incidence of respiratory disease but led to fewer severe cases being admitted to hospital and quarters.

Limited data indicated that prophylactic sulfadiazine maintained its protective action for as long as 18 consecutive weeks. Similarly, a second course of chemoprophylaxis was as effective as the first.

These controlled observations in the Air Force Service Command were striking. The effect of general use of the method by all air force troops during the first three months of 1945 was not reflected in the rates for the Air Force as a whole, when compared with the general theater rate for common respiratory diseases during that time. The rates for the Ground Forces who were never on sulfadiazine averaged better. The Air Force rates were lower than those for the Communications Zone troops but that had been a constant characteristic throughout the activities of the theater. In the presence of very high infection rates with

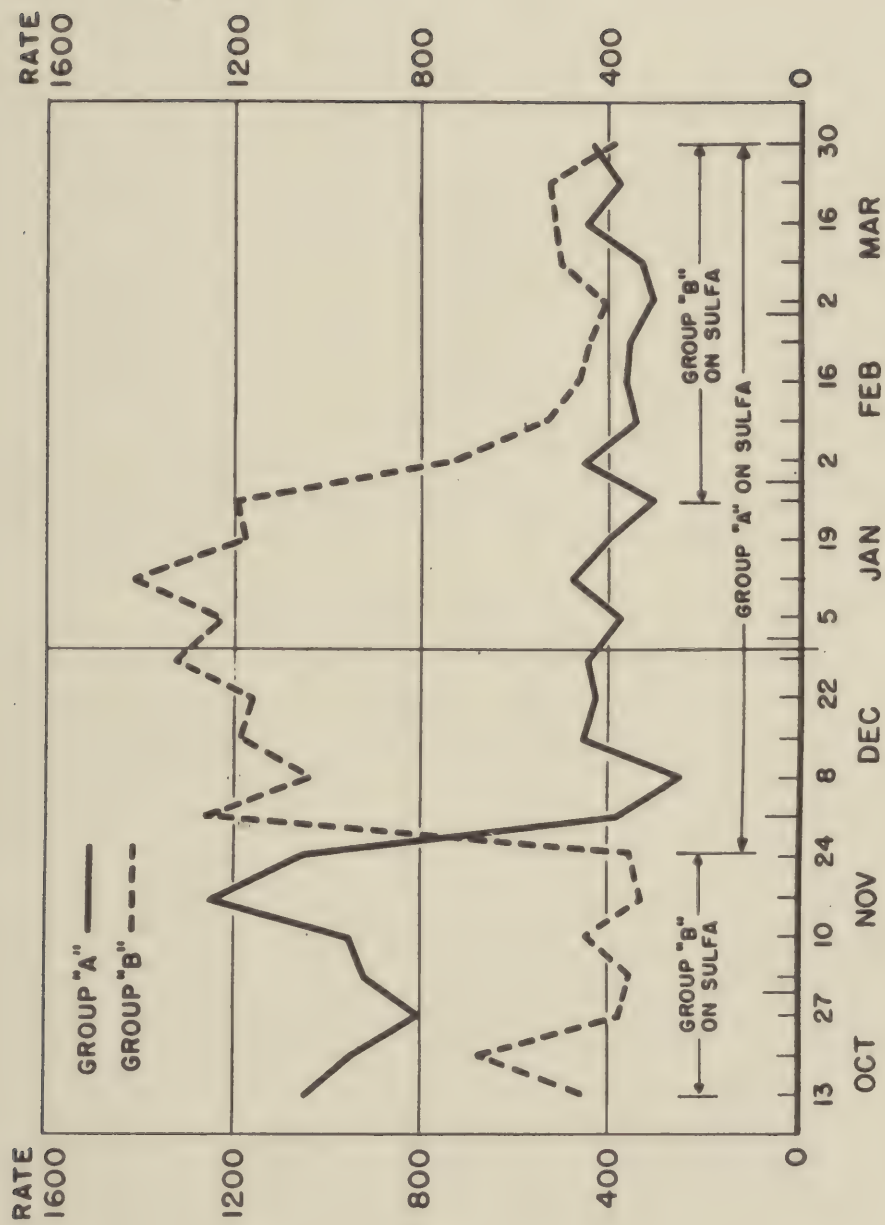


Figure 13. Sulfadiazine in chemoprophylaxis of acute upper respiratory infection, 8th Air Force Service Command, October 1944 to March 1945 inclusive.





streptococcus, meningococcus or other susceptible organisms, this procedure may be immediately and significantly helpful. The secondary factor of an increased sensitivity of individuals to the drug and the development of sulfa-resistant microorganisms should be carefully weighed against the possible benefits in each situation.

A second controlled investigation of sulfadiazine prophylaxis of respiratory disease was undertaken among the enlisted detachment of the 154th General Hospital. These studies began early in November 1944 and lasted until late March 1945, a period of some five months. They consisted of careful clinical and laboratory observations of each man, with the principal object of determining in detail what might be expected from an accepted method of drug prophylaxis when applied to a small body of men in the United Kingdom living with a minimum of disturbance of environment such as those brought about by troop movements, field exposure or large transfers of personnel. Useful information could conceivably be gained regarding the value of individualization as opposed to the mass employment of drug prophylaxis, with additional contribution brought about through the possibility of coincident bacteriological observations.

The number of men available for study was about 490. They were quartered in 31 huts, sleeping 16 to 18 men in each. Half of the men in each hut received sulfadiazine. In this way the control group was made up from representatives of each hut and the contact experience of both drug-treated and control groups was as nearly the same as it was possible to make it. In half of the barracks the prophylactic dose of sulfadiazine for test subjects was 0.5 gram and for the remainder 1.0 gram.

An individual clinical and laboratory record was kept for each man. A history of respiratory and allergic disease and certain other relative items including sulfonamide reactions and throat cultures, were obtained before drug preventive was started. During the period of study each man was seen at least once every two weeks and immediately whenever symptoms of disease developed. The study terminated 15 March 1945. No severe toxic reaction were encountered. Six men showed microscopic hematuria. There were two cases of hemolytic streptococcus sore throat in the treated group. The incidence of mild respiratory infection was about the same for both treated and control groups.





Table 1

Infections of the Respiratory Tract

European Theater of Operations, U. S. Army

Cases and rates per 1000 strength per annum, per year

February 1942 to June 1945 Inclusive

Year	Combined Total Respiratory Infections and Pneumonias		Acute Upper Respiratory Infection		The Pneumonias						Total Pneumonias	
					Primary Lobar		Primary Atypical		Secondary			
	Cases	Rate	Cases	Rate							Cases	Rate
1942	21,984	303	21,151	291	629	8.7	184	2.5	20	0.3	833	11.5
1943	111,263	421	108,133	409	1,447	5.5	1,611	6.1	72	0.3	3,130	11.8
1944	222,140	151	209,281	142	5,182	3.5	7,458	5.1	219	0.1	12,859	8.7
1945	169,303	124	154,117	112	4,788	3.5	10,224	7.5	174	0.1	15,186	11.1
Total	524,690	165	492,682	155	12,046	3.8	19,477	6.1	485	0.2	32,008	10.1

Source: Division of Medical Statistics, Office of The Surgeon General, War Department,  
Washington, D. C.

Table 2

Infections of the Respiratory Tract

European Theater of Operations, U. S. Army

Deaths and rates per 1000 per annum, by years

February 1942 to June 1945 Inclusive

Disease	Total		1942		1943		1944		1945	
	Deaths	Rate	Deaths	Rate	Deaths	Rate	Deaths	Rate	Deaths	Rate
Common Respiratory	6	.0019	0	-	0	-	1	.0007	5	.0036
Influenza	1	.0003	0	-	1	.0038	0	-	0	-
Pneumonia, Primary	64	.0201	0	-	2	.0076	30	.0204	32	.0234
Pneumonia, Secondary	29	.0091	0	-	0	-	6	.0041	23	.0168
Pneumonia, Primary Atypical	41	.0129	0	-	0	-	8	.0054	33	.0241
Total	141	.0443	0	-	3	.0114	45	.0306	93	.0679

Source: Division of Medical Statistics, Office of The Surgeon General, War Department, Washington, D.C.

Table 3

Common Respiratory Disease, Including Influenza  
European Theater of Operations, U. S. Army  
Cases and rates per 1000 strength per annum, by months  
February 1942 to June 1945 Inclusive

Month	Total		1942		1943		1944		1945	
	Cases	Rate	Cases	Rate	Cases	Rate	Cases	Rate	Cases	Rate
January	65791	245			7705	704	25574	416	32512	166
February	60065	211	228	739	4359	516	23206	330	32272	157
March	69122	183	413	523	3383	408	32212	312	33114	125
April	42939	133	284	324	2777	263	19598	211	20280	93
May	35527	106	268	126	2033	216	13955	139	19271	87
June	29472	73	295	83	2092	173	10417	82	16668	63
July	9982	74	800	125	2212	116	6970	64		
August	10532	68	1150	131	2264	117	7118	56		
September	16695	84	2158	170	3174	136	11363	69		
October	27229	141	4549	272	8628	236	14052	101		
November	51591	252	5725	514	28666	700	17200	112		
December	73737	245	5281	566	40840	628	27616	122		
Total	492682	155	21151	291	108133	409	209281	142	154117	112

Source: Division of Medical Statistics, Office of The Surgeon General, War Department, Washington, D.C.



Table 4

Common Respiratory Diseases Including Influenza White and Colored, European Theater of Operations, U. S. Army  
 Admission rates per 1000 strength per annum, by weeks in  
 United Kingdom, 3 September 1943 - 30 June 1944, and in  
 Continental Europe, 1 September 1944 - 29 June 1945

Week Ending	White	Colored	Week Ending	White	Colored
1943 September 3	120	90	1944 September 1	30	16
10	142	58	8	29	19
17	138	54	15	34	26
24	154	103	22	37	23
October 1	220	338	29	60	28
8	*	*	October 6	85	46
15	216	60	13	95	56
22	237	69	20	85	54
29	320	116	27	73	69
November 5	378	177	November 3	85	70
12	506	407	10	87	71
19	746	415	17	118	74
26	1129	477	24	104	53
December 3	890	370	December 1	90	51
10	635	396	8	101	71
17	615	365	15	112	92
24	509	283	22	120	86
31	399	258	29	114	72
1944 January 7	405	199	1945 January 5	140	105
14	384	173	12	151	134
21	396	211	19	154	124
28	396	216	26	167	109
February 4	365	269	February 2	174	104
11	348	242	9	188	116
18	337	202	16	150	106
25	356	236	23	120	97
March 3	354	233	March 2	118	94
10	350	225	9	132	99
17	319	230	16	125	93
24	290	201	23	109	82
31	249	156	30	109	72
April 7	244	212	April 6	99	72
14	220	168	13	96	64
21	201	144	20	88	58
28	166	118	27	84	61
May 5	147	90	May 4	*	*
12	140	119	11	96	58
19	133	103	18	85	56
26	121	108	25	77	53
June 2	113	91	June 1	70	48
9	89	73	8	71	50
16	84	61	15	60	53
23	76	45	22	61	45
30	80	56	29	59	35

\*Data not available.

Source: Division of Medical Records, Office of the Chief Surgeon, ETO.

Table 5

Common Respiratory Diseases Including Influenza  
 United Kingdom and Continental Europe  
 European Theater of Operations, U. S. Army  
 Admission rates per 1000 strength per annum, by weeks  
 1 September 1944 to 29 June 1945 Inclusive

Week Ending	United Kingdom	Continental Europe	Week Ending	United Kingdom	Continental Europe
1944 Sept. 1	98	28	1945 Feb. 2	211	163
8	106	28	9	208	177
15	134	33	16	212	143
22	148	35	23	218	115
29	162	57	March 2	210	116
Oct. 6	163	81	9	192	126
13	153	91	16	205	120
20	146	82	23	181	104
27	142	73	30	185	103
Nov. 3	145	83	April 6	153	94
10	161	86	13	148	91
17	178	113	20	140	83
24	149	99	27	139	80
Dec. 1	149	86	May 4	131	82
8	147	98	11	129	90
15	176	110	18	128	81
22	184	117	25	103	73
29	200	110	June 1	101	66
1945 Jan. 5	270	137	8	98	68
12	276	149	15	103	58
19	229	151	22	121	58
29	196	158	29	88	55

Source: Division of Medical Records, Office of the Chief Surgeon, European Theater of Operations.

Table 6

Common Respiratory Diseases Including Influenza  
Air Forces and Communications Zone, United Kingdom and Continental Europe  
European Theater of Operations, U. S. Army  
1 September 1944 to 29 June 1945

Week Ending	Air Forces		Communications Zone		Week Ending	Air Forces		Communications Zone	
	United Kingdom	Continental Europe	United Kingdom	Continental Europe		United Kingdom	Continental Europe	United Kingdom	Continental Europe
1944 Sept 1	109	*	97	11	1945 Feb 2	167	141	242	187
8	117	*	102	41	9	160	133	246	183
15	157	*	129	57	16	157	122	262	177
22	163	52	138	53	23	147	127	236	158
29	180	73	151	88	2	159	111	211	157
Oct 5	184	103	139	100	9	151	126	203	157
13	172	116	142	123	16	162	126	180	149
20	165	96	140	108	23	165	116	168	149
27	134	101	170	106	30	161	116	199	134
Nov 3	153	81	151	120	6	143	93	140	122
10	174	92	183	134	13	150	89	123	124
17	175	134	202	152	20	143	94	102	98
24	153	121	157	132	27	133	88	145	91
Dec 1	157	109	159	111	4	127	*	135	*
8	158	121	193	126	11	130	80	113	60
15	205	123	196	140	18	124	93	119	89
22	199	141	222	169	25	109	75	81	88
29	209	149	243	152	1	106	72	75	79
1945 Jan 5	265	163	294	180	8	112	105	76	71
12	272	166	303	223	15	115	73	75	66
19	206	157	277	237	22	134	64	81	68
26	166	146	128	206	29	92	61	71	69

\*Data not available

Source: Division of Medical Statistics, Office of the Chief Surgeon, European Theater of Operations.



Table 7

Common Respiratory Diseases Including Influenza  
 By major components for Continental Europe  
 European Theater of Operations, U. S. Army  
 Admission rates per 1000 strength, by weeks  
 1 September 1944 to 29 June 1945, inclusive

Week Ending	Total Combat	Ground Forces	Air Forces	Ground Forces Repl. Command	Communica- tions Zone
1944 Sept. 1	28	17	*	*	11
8	28	17	*	*	41
15	33	25	*	*	57
22	35	40	52	*	53
29	57	57	73	*	88
Oct. 6	81	82	103	*	100
13	91	95	116	70	123
20	82	86	96	93	108
29	73	83	101	68	106
Nov. 3	83	89	81	86	120
10	86	83	92	105	134
17	113	122	134	147	152
24	99	100	121	138	132
Dec. 1	86	106	109	125	111
8	98	101	121	112	126
15	110	108	123	144	140
22	117	99	141	146	169
29	110	111	149	159	152
1945 Jan. 5	137	126	163	190	180
12	149	137	166	213	223
19	151	131	157	297	237
26	158	139	146	354	206
Feb. 2	163	188	141	527	187
9	177	184	133	356	183
16	143	144	122	303	177
23	115	102	127	304	158
March 2	116	103	111	291	157
9	126	110	126	308	157
16	120	102	126	257	149
23	104	84	116	225	150
30	103	73	116	189	134
April 6	94	68	93	135	122
13	91	65	89	173	124
20	83	60	84	119	98
27	80	58	88	138	91
May 4	82	64	81	131	111
11	90	63	80	140	100
18	81	61	93	126	89
25	73	58	75	94	88
June 1	66	56	72	77	79
8	68	58	105	84	71
15	58	53	73	73	66
22	58	52	64	81	68
29	55	54	61	57	69

\*No data available.

Source: Division of Medical Records, Office of the Chief  
 Surgeon, European Theater of Operations

Table 8

Common Respiratory Diseases Including Influenza, By Armies  
European Theater of Operations, U. S. Army  
Admission rates per 1000 strength per annum, by weeks  
16 September 1944 to 29 June 1945 Inclusive

Week Ending	1st Army	3rd Army	7th Army	9th Army	15th Army
1944 Sept. 16	27	23		25	
23	45	34		29	
30	67	44		38	
Oct. 6	116	61		39	
13	112	89		73	
20	96	80		79	
27	80	92		74	
Nov. 3	72	92		101	
10	84	93		79	
17	130	137		94	
24	91	113	139	94	
Dec. 1	107	115	124	90	
8	97	89	101	88	
15	85	107	122	94	
22	89	86	108	74	
29	113	112	117	87	
1945 Jan. 5	150	130	127	82	
12	170	124	145	84	
19	168	108	146	91	
26	172	130	153	92	
Feb. 2	204	185	225	136	
9	162	213	222	137	
16	126	171	176	103	
23	87	109	135	89	67*
March 2	93	113	131	71	93
9	90	126	140	88	65
16	90	114	134	64	84
23	83	83	101	61	73
30	71	57	105	61	54
April 6	64	62	88	54	82
13	56	58	98	50	71
20	51	55	86	46	71
27	64	51	90	45	48
May 4	65	45	111	48	48
11	54	47	96	76	60
18		51	93	53	57
25		56	80	45	59
June 1		46	98	41	59
8		45	97	48	56
15		60	47		50
22		56	47		56
29	Relieved	55	45		69

\*First Report received on Continent.

Source: Division of Medical Records, Office of the Chief Surgeon, European Theater of Operations.

Table 9

Common Respiratory Diseases, Including Influenza  
Continental United States and European Theater of Operations, U.S. Army  
Cases and rates per 1000 strength per annum, by months  
January 1942 to June 1945 Inclusive

Month	Continental U. S.		European Theater of Operations	
	Cases	Rates	Cases	Rates
1942 January	43385	311		
February	56496	434	228	736
March	60106	406	413	523
April	41686	262	284	324
May	41905	196	268	126
June	26731	143	295	83
July	26831	109	800	125
August	24306	115	1150	131
September	31386	139	2158	170
October	48844	159	4549	272
November	71251	260	5725	514
December	144019	492	5281	566
Total	616946	243	21151	291
1943 January	212537	500	7705	704
February	141980	382	4359	516
March	134772	354	3383	408
April	142156	287	2777	263
May	84361	208	2033	216
June	55705	136	2092	173
July	51294	101	2212	116
August	38438	95	2264	117
September	38842	97	3174	136
October	51096	104	8628	236
November	60829	160	28666	700
December	256176	546	40840	628
Total	1268186	247	108133	409
1944 January	124926	341	25574	416
February	96377	272	23206	330
March	91230	214	32212	312
April	53054	160	19598	211
May	38781	120	13955	139
June	30749	78	10417	82
July	20381	66	6970	64
August	20253	67	7118	56
September	29375	81	11363	69
October	25241	92	14052	101
November	24377	93	17200	112
December	35341	115	27616	122
Total	590085	147	209281	142
1945 January	38835	167	32512	166
February	42612	192	32272	157
March	45148	167	33114	125
April	26476	122	20280	93
May	27281	124	19271	87
June	28592	101	16668	63
Total	208944	145	154117	112
Grand Total	2684161	204	492682	155

Source: Division of Medical Statistics, Office of The Surgeon General, War Department, Washington, D.C.



Table 10

Common Respiratory Disease, Including Influenza  
By Theaters of Operations  
Cases and rates per 100 strength per annum  
January 1942 to June 1945 Inclusive

Theater	Total			1942			1943			1944			1945		
	Cases	Rate		Cases	Rate		Cases	Rate		Cases	Rate		Cases	Rate	
Total Armies	3796648	179		700725	230		1555893	231		1052281	140		487749	126	
Continental U. S.	2684161	204		616946	243		1268186	247		590085	147		208944	145	
Total Overseas	1112487	138		83779	163		287707	181		462196	132		278805	115	
Alaska	57495	212		12239	244		25469	222		15628	188		4159	178	
North America	33601	198		10382	256		15834	221		5660	144		1725	111	
Africa-Middle East	25403	195		1161	202		10732	201		10364	219		3146	132	
China-Burma-India	53080	160		855	150		7321	159		28099	176		16805	139	
European	492682	155		21151	291		108133	409		209281	142		154117	112	
Mediterranean	202701	150		3232	152		61201	142		106571	162		31697	132	
Southwest Pacific	126627	105		9958	149		21134	108		45722	83		49813	128	
Latin America	35242	101		11595	133		12478	103		7323	85		3846	99	
Pacific Ocean	85656	82		13206	90		25405	86		33548	85		13497	65	

Source: Division of Medical Statistics, Office of The Surgeon General, War Department, Washington, D. C.

Table 11

Upper Respiratory Infections Among Troops on Transports

European Theater of Operations, U. S. Army

Cases and attack rates per 100

August and September 1942

Unit	Number in Unit	Number Contacting Respiratory Infections	Attack rates per 100
A	60	48	80
B	39	26	67
C	52	37	71
Total	151	111	74

Source: Division of Preventive Medicine, Office of  
the Chief Surgeon, European Theater of  
Operations.

Table 12

Upper Respiratory Infection Among 151 Nurses in Transit  
from Zone of Interior to European Theater of Operations  
by date of onset  
August - September 1942

Date		Cases
1944 August	1	1
	2	1
	3	0
	4	0
	5	0
Left New York	6	3
	7	1
	8	2
	9	2
	10	8
	11	1
	12	4
	13	1
	14	7
	15	13
	16	9
Arrived in U. K.	17	13
Arrived at Staging Area	18	12
	19	4
	20	4
	21	1
	22	7
	23	2
	24	3
	25	0
	26	0
	27	1
	28	1
	29	1
	30	3
	31	1
September	1	2
	2	0
	3	1
	4	1
	5	1
Total		111

Source: Division of Preventive Medicine,  
Office of the Chief Surgeon,  
European Theater of Operations.



Table 13

Crude Incidence Rates for Upper Respiratory Infections

United States Troops Aboard U. S. Army Transports

July - September 1942

Group Surveyed	No. of Indi- viduals	Period A (Pre-embarkation)			Period B (Transit)			Period C (After arrival)		
		Dates	No. of Colds	Rate per 100	Dates	No. of Colds	Rate per 100	Dates	No. of Colds	Rate per 100
Army Nurse Corps Units, Salisbury	151	Aug 1-4	2	1.3	Aug 5- 18	76	50.3	Aug 19- Sept 5	33	21.9
16th Medical Regiment, Swindon	592	July 15- Aug 4	15	2.5	Aug 5- 18	209	35.3	Aug 19- Sept 7	74	12.5
28th Signal Bat- talion, Maidenhead	238	Aug 10- 30	15	6.3	Aug 31- Sept 6	57	23.9	Sept 7- 23	106	44.5

Source: Division of Preventive Medicine, Office of the Chief Surgeon, European Theater of Operations.

Table 14

Daily Incidence Rates of Upper Respiratory Infections

U. S. Army Transports, July - September 1942

(Corrected for length of survey period and for susceptibility)

Group Surveyed	Period A (Pre-embarkation)			Period B (Transit)			Period C (After arrival)		
	No. of Sus- ceptibles* (In person- days)	No. of colds	Daily rate per 100	No. of Sus- ceptibles* (In person- days)	No. of colds	Daily rate per 100	No. of Sus- ceptibles* (In person- days)	No. of colds	Daily rate per 100
Army Nurse Corps, Units Salisbury	599	2	0.3	1886	76	4.0	1767	33	1.9
	12114	21	0.2	6721	209	3.1	8385	74	0.9
28th Signal Battalion Maidenhead	4758	15	0.3	1368	57	4.2	1919	105	5.5

\*Individuals are considered as non-susceptible while actually having a cold.

Source: Division of Preventive Medicine, Office of the Chief Surgeon, European Theater of Operations.

Table 15

Upper Respiratory Infection  
By Date of Onset  
U. S. Army Transports  
July - September 1942

Period	16th Medical Regiment				28th Signal Battalion			
	Dates	No. of days	No. of colds	U.R.I. per day	Dates	No. of days	No. of colds	U.R.I. per day
A  (Pre- embar- kation)	July 15-21	7	4	0.6	Aug. 10-16	7	2	0.3
	July 22-28	7	5	0.7	Aug. 17-23	7	7	1.0
	July 29 Aug. 4	7	12	1.7	Aug. 24-30	7	6	0.9
B  (Trans- it)	Aug. 5-6	2	17	8.5	Aug. 31 Sept. 1	2	6	3.0
	Aug. 7-9	3	73	24.3	Sept. 2-4	3	42	14.0
	Aug. 10-12	3	45	15.0	Sept. 5-6	2	9	4.5
	Aug. 13-15	3	48	16.0				
	Aug. 16-18	3	26	8.7				
C  (After arrival)	Aug. 19-21	3	30	10.0	Sept. 7-9	3	48	16.0
	Aug. 22-25	4	19	4.8	Sept. 10-16	7	36	5.1
	Aug. 26 Sept. 1	7	9	1.3	Sept. 17-23	7	21	3.0
	Sept. 2-7	6	15	2.5				

Source: Division of Preventive Medicine, Office of The Chief Surgeon, European Theater of Operations.



Table 16

Severity of Upper Respiratory Infections

U. S. Army Transports, July - September 1942

Period	16th Medical Regiment							28th Signal Battalion						
	No. of U.R.I.	Mild		Moderate		Severe		No. of U.R.I.	Mild		Moderate		Severe	
		No.	Per- cent	No.	Per- cent	No.	Per- cent		No.	Per- cent	No.	Per- cent	No.	Per- cent
A (Pre-embarkation)	8	2	25.0	2	25.0	4	50.0	15	7	46.7	6	40.0	2	13.3
B (Transit)	78	48	61.5	19	24.4	11	14.1	57	32	56.1	20	35.1	5	8.8
C (After arrival)	31	19	61.3	8	25.8	4	12.9	105	50	47.6	34	32.4	21	20.0
Total	117	69	59.0	29	24.8	19	16.2	177	89	50.3	60	33.9	28	15.8

Data on severity were obtained on only 117 of the 304 colds in the 16th Medical Regiment.

Source: Division of Preventive Medicine, Office of the Chief Surgeon, European Theater of Operations.

Table 17

Duration of Upper Respiratory Infection

U. S. Army Transports

July - September 1942

Duration	16th Medical Regiment		28th Signal Battalion	
	Number	Percent of Total	Number	Percent of Total
1 - 7 days	97	33.0	28	43.1
8 - 14 days	29	9.9	4	6.1
15 - 21 days	13	4.4	0	0
Over 21 days	155	52.7	33	50.8
Total, known duration	294	100.0	65	100.0

Note: Ten colds in the 16th Medical Regiment and 112 in the 28th Signal Battalion are not included in the above table, as they were still present at the time of the survey with onsets less than 21 days previous.

Source: Division of Preventive Medicine, Office of the Chief Surgeon, European Theater of Operations.





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A HISTORY OF PREVENTIVE MEDICINE  
IN THE  
EUROPEAN THEATER OF OPERATIONS  
UNITED STATES ARMY  
1941 - 1945

Part III - Epidemiology  
Section 3 - Acute Respiratory Infections  
Number 2 - Influenza

by

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### PART III

#### Epidemiology

#### Section 3 - Acute Respiratory Infections

#### Number 2 - Influenza

The confusion and lack of definiteness which arises in the clinical diagnosis of influenza in nonepidemic times and the tendency to designate most acute infections of the respiratory tract as influenza when an epidemic of that disease prevails, leads to a situation where no clear idea can be derived of how frequently or to what extent influenzal infections occurred in the European Theater. The attitude of the purist that the diagnosis of influenza should be made only when an influenza virus is identified in the course of an acute respiratory infection is impractical. The complicated nature of the laboratory methods make them available only to a few hospitals through specially staffed laboratories. Under that policy, only a fraction of actual cases would be reported.

The use of epidemiological criteria in diagnosis served with relative accuracy in times of epidemic, provided the diagnosis of influenza was limited to cases which were clinically typical, occurred in groups, and adequate sampling had demonstrated the frequent and widespread distribution of an influenza virus.

The principal error came in nonepidemic periods, due to the frequent interpretation of the seasonal waves of simple upper respiratory infection as of influenzal nature. The years 1942 and 1943 present a curious paradox, in that influenza was epidemic in 1943 and not in 1942, and yet the reported rates for influenza in 1942 greatly exceeded those of the epidemic year. (Table 1.) Influenza virus had been identified among the civilian population of Great Britain in 1941, and there was some reason to believe that the infection may have carried over into the early months of 1942. The outbreak never reached the proportion of the subsequent epidemic in the winter of 1943-1944. The first American troops did not arrive in the United Kingdom, however, until late January of 1942, and the numbers at risk were never great during the first quarter of the year. The rates for respiratory disease among American soldiers were then relatively great, but could not have exerted sufficient influence through the numbers of actual cases of influenza that might have occurred, to give a rate for the year of 23.1 per thousand. Furthermore, influenza virus was never determined to have existed that year in the American military population.



The low rates for influenza during 1944 and 1945 were compatible with existing information from other sources. The British Isles were free of the disease during those years, as was the European continent during the period of military operations; except that the virus of influenza was identified in some few scattered instances in late 1945, and occasional localized outbreaks were believed epidemiologically to have been of that nature.

The Clinical Disease.--The clinical manifestations of influenza in the 1943 epidemic were those of a mild and uncomplicated disease. The incubation period was short, a matter of about 48 hours. The onset was abrupt, occasionally with a slight rigor, and the initial symptoms were predominately constitutional rather than local. They consisted chiefly of prostration, aching pains in the legs and back and anorexia. A moderate cough was common, but was neither paroxysmal nor violent. The fever rarely exceeded 102° F. although occasionally it reached 104° F. It usually lasted but one or two days. During convalescence, which began rapidly about the third day, catarrhal symptoms were often prominent.

The Course of the Epidemic.--That influenza appeared in epidemic proportions in the autumn of 1943 was by no means unexpected. Interepidemic influenza in Great Britain had demonstrated a characteristic two-year cycle. The disease had last been prevalent in the United Kingdom during the winter of 1941-42.

The late spring and early summer months of 1943 had furthermore been marked by a series of unusual outbreaks of acute respiratory disease. They were limited in time and space and appropriate laboratory examinations determined that almost all were due to influenza virus of type A. These outbreaks continued to appear in June, July, September, and October. Ever since studies of the influenza virus had been initiated in Great Britain in 1933, the A type of the virus had never been observed later than April nor earlier than December.

Similar events to those noted for the British civilian and military populations also occurred among American troops; such as the small localized epidemic in the Southern Base Section in early August, an outbreak clinically typical of influenza although unconfirmed bacteriologically.

The first statistical evidence of the beginning wave of increased incidence came in the week ending 12 November 1943. The usual autumnal increase in reported cases of upper respiratory disease had started in accord with usual experience in mid-September (Figure 1, Table 2) but the average rates for the theater were actually somewhat less than for the corresponding period of the preceding year. The last week in October and the first week in November showed a suggestive upward surge.

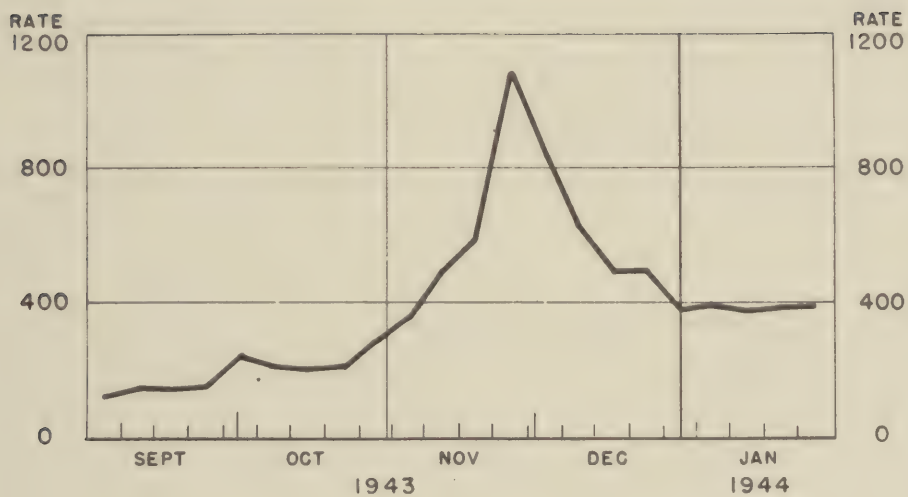


Figure 1.

Common respiratory diseases including influenza, European Theater of Operations, U. S. Army, admission rates per 1000 strength per annum, by weeks, 3 September 1943 to 28 January 1944 inclusive.





The probable nature of the responsible infectious agent was suggested at this time, and in advance of statistical confirmation of the beginning epidemic, by repeated reports from clinicians in general and other hospitals that the clinical nature of the existing disease was different from the ordinary respiratory disease previously prevalent, and more like influenza.

The statistical reports of 12 November 1943 left no doubt that an epidemic was in the making. The increase in reported cases, thereafter, was extremely rapid, to reach a maximum rate of 1,079 cases per thousand strength per annum for the week ending 26 November 1943. This was measurably in excess of recorded experience, in the previous year, by more than sixty percent. The decline of the epidemic curve was as sharply marked as its sudden rise. By the last week of December the rate was 387, a satisfactory endemic level for that time of year. The remainder of the winter season continued uneventfully.

The course of the epidemic as traced above is presented in terms of common respiratory diseases including influenza, for reasons that have already been brought out. Despite the unpredictability in the reporting of influenza in ordinary times, it tends to conform to type during the presence of an actual epidemic of that disease. This was true in this instance.

The curve of reported influenza during the period of the outbreak rather closely paralleled that of the simple respiratory infections, although the magnitude was measurable less. The shape of the influenza curve also presented certain differences, in that the period of peak incidence was carried over into December, whereas the actual course of the epidemic reached its height in the week of 26 November 1943. This was without doubt a reflection of styles in reporting. Once the reporting of influenza had started, it tended to continue; and while the rates dropped precipitously in January they were still in excess of established annual averages through February, March, and April.

It is scarcely necessary to observe that the actual incidence of influenza throughout the course of the epidemic was greatly in excess of the cases recorded as such; and that the great proportion of influenzal infections were reported as common respiratory disease. (Table 1.)

Geographic Distribution. The geographical spread is best illustrated by the behavior of the disease in the several base sections. The outbreak was first noted as a series of isolated epidemics in the Eastern Base Section, to be followed almost concurrently by a similar series of events in the Central Base Section. The eastern area was largely occupied by the Air Forces, and the central was made up principally of London and its immediately surrounding territory.

The district of East Anglia in the Eastern Base Section, was first involved. The rates for respiratory infection had been greater in this base section, compared with the rest of the area of the theater, since early September. The epidemic extended promptly to the London area, to the Southern Base Section during the week of 29 October 1943 and within days to the Western Base Section. From then on, there was a more or less universal sweep over all of Great Britain, with the peak of the outbreak occurring in all four base section areas during the week of 26 November 1943. The course of the epidemic in the several base sections is illustrated in the composite graphs of Figure 2, Table 3.

The outbreak did not become manifest in the relatively isolated North Ireland Base Section until the last week in October, did not attain real headway until the third week in November, and the peak was delayed until the week of 3 December 1943.

In the course of its spread, the entire area occupied by American troops was involved, but the attack rates for other areas were never as great as in the two base sections where the outbreak appears to have started. The epidemic situation as of 3 December 1943 is shown in Figure 3. The concentration of cases of influenza coincides almost precisely with the concentration of troops.

Influenza in the Various Forces of the Command.--The sharp rise in the epidemic curve was reflected in the rates for all three major components of the command, although there were individual variations in magnitude. The rates for the Services of Supply reached the highest level and the Air Forces were next. The shape of the curve for the Ground Forces was neither characteristic of influenza nor of the experience of the other two forces, because of well-marked differences in the time and extent with which the outbreak struck various major units. Consequently the epidemic curve never reached a cumulative peak of the height noted for the other services. The total attack rate for the epidemic, as a whole, was essentially the same, for, while the epidemic was less sharply marked among the ground Forces, it was more prolonged. (Figure 4, Table 4.)

The Ground Force unit first affected was the 101st Airborne Division during the week of 29 October 1943, and that organization likewise had a greater number of cases in the course of the outbreak than any other major unit of long residence in Great Britain. The peak was great, and the wave relatively long continued.

The Second Armored Division arrived in the theater during the latter part of November, just as the epidemic was at its height. The attack rate was greater than for any other division, the peak of incidence was higher and it naturally appeared much later, on 17 December 1943. The same sharp curve, but of somewhat lesser magnitude, was noted for the Ninth Infantry Division, which also arrived in the United Kingdom late in November.



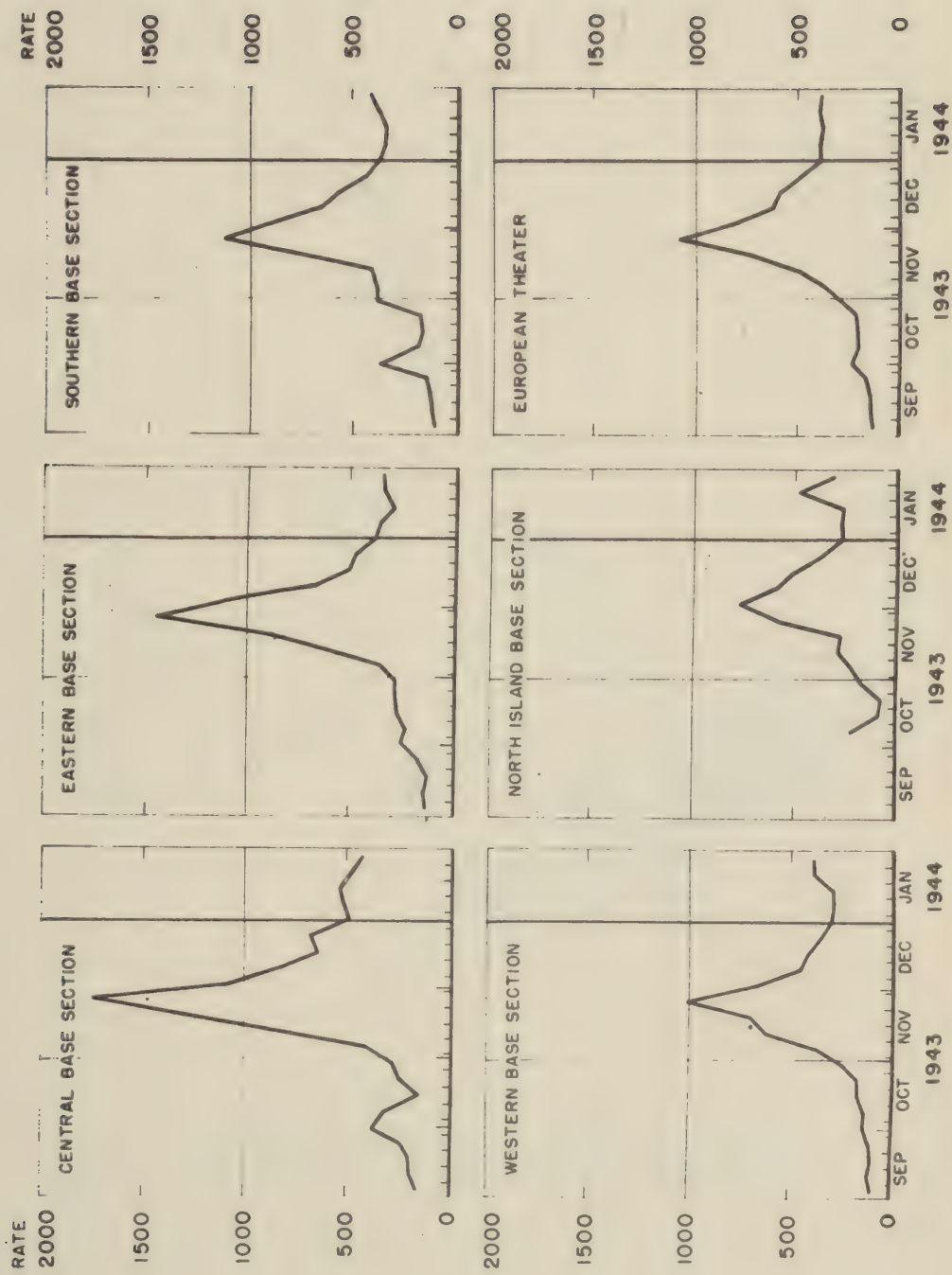


Figure 2. Common respiratory diseases including influenza, Base Sections, European Theater of Operations, U. S. Army, admission rates per 1000 strength per annum, by weeks, 3 September 1943 to 28 January 1944 inclusive.







Figure 3

Geographic distribution of common respiratory diseases, U. S. Army in the United Kingdom, 3 December 1943.





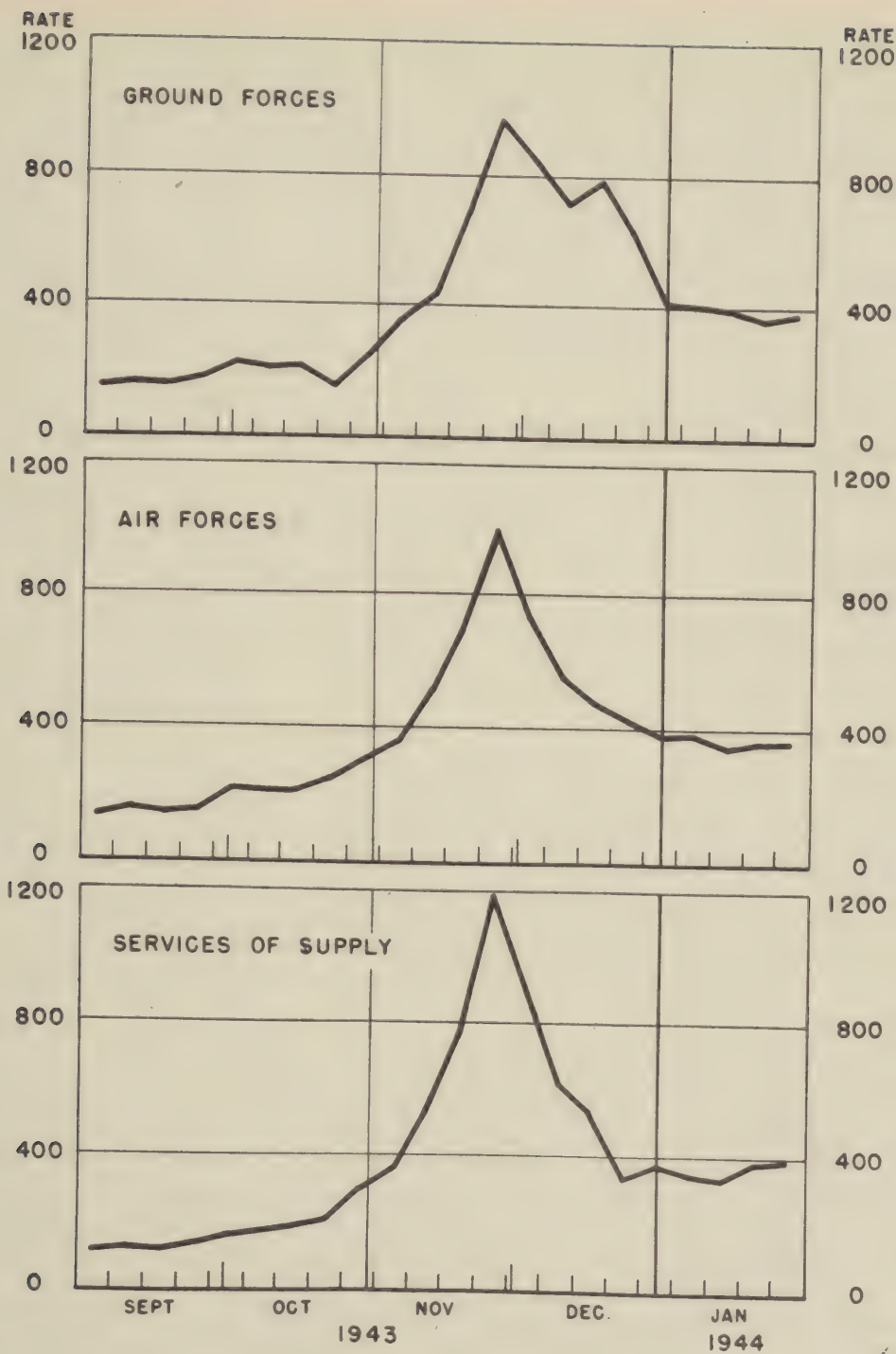


Figure 4

Common respiratory diseases including influenza, major commands, European Theater of Operations, U. S. Army, admission rates per 1000 strength per annum, by weeks, 3 September 1943 to 28 January 1944 inclusive.



The reaction of various other Divisions to the epidemic (Figure 5, Table 5) brings out several epidemiologic factors. No correlation could be shown between the length of service in Great Britain and the incidence of influenza. The oldest division in point of service in Great Britain was the 29th Infantry Division. The attack rate in that organization was essentially the same as the average for the theater. The 5th Infantry Division, which had long been stationed in Iceland, had transferred to Great Britain in North Ireland in early October, had a rate much like that of the 29th Division which was at the theater average.

Other divisions such as the First and Second Infantry Divisions and the Third Armored Division had distinctly low rates. The 1st Infantry was a veteran unit recently arrived in Great Britain from North Africa, which the 2d Infantry was fresh from the Zone of the Interior with the epidemic just under way. The 3rd Armored Division had been in the theater since September, well before the outbreak.

The rates for the 101st Airborne Division and the 28th Infantry Division were appreciably in excess of average experience. The Airborne Division had been in England since early September, the 28th Infantry since late October when the epidemic was just getting under way.

It was evident that the distinct variations in the attack rate were not dependent upon length of residence in the theater, although in all instances influenza attacked seasoned troops to a much greater extent than had the ordinary respiratory infections of the preceding two years. Many veteran units showed the same lack of resistance to influenza as did units of relatively recent origin, although accumulated experience had repeatedly shown the latter to be more susceptible to common respiratory infection.

The course of the epidemic among ground force troops, considered as a whole, was largely influenced by the arrival of the 2d Armored Division and the 9th Infantry Division at the height of the outbreak. It has long been recognized that the introduction of healthy units into a station where an epidemic is in progress tends to exaggerate and prolong the epidemic. These two divisions did not join other troops, but occupied individual camps. Nevertheless, influenza struck sharply and severely, with a peak of incidence that was greater than that of most divisions, and a course that was more prolonged. Presumably this was due to more or less simultaneous exposure of all susceptibles to a full-blown epidemic, with no opportunity for such progressive salting of the herd as occurs even with an influenzal infection, thereby tending to limit explosiveness and extent. The general effect on the broad aspect of the epidemic as it involved ground forces of the theater was, therefore, the same exaggeration and prolongation of the process as that which follows introduction of a fresh unit into an infected post.



Racial Differences in Attack Rates.--The incidence of epidemic influenza among colored troops was measurably less than that for white troops of the theater. (Figure 6) (Table 4, Section 3, Number 1.) During the week of greatest incidence for the theater as a whole, that of 26 November, the rate for white troops was 1,129, that for colored 477.

The differences each week throughout the epidemic were obviously statistically significant. They were greater than those demonstrated between white and colored troops during nonepidemic times. No quantitative measure can be given and no categorical statement can be made which will indicate that the difference between white and colored rates during the epidemic was more significant or was less significant than such difference in nonepidemic periods. Table 6 shows the epidemic to normal ratio for white, the epidemic to normal ratio for colored, and the ratio of white epidemic-normal differences to colored epidemic-normal differences.

It will be noted that the average white ratio of epidemic to normal was 6.0, whereas the comparable average colored ratio was 4.3. The average ratio of the white epidemic-normal differences to the colored-normal differences was 2.2.

The distribution of colored troops was fairly uniform throughout the several base sections and all were members of the Services of Supply. The differences that were noted were not related to white troops having been stationed predominantly in a part of the theater more affected than another.

Frequency of the Pneumonias During the Epidemic Period.--The significant epidemiologic feature of an epidemic of influenza is the extent to which it brings about increased rates for the pneumonias. The deaths from influenza are deaths from secondary pneumonia.

The 1943 outbreak was almost completely unassociated with an increased prevalence of primary and secondary pneumonia. The greater rates noted for the months of November and December of 1943 and for January of 1944 are no more than would be anticipated in the course of the usual seasonal increase of these infections. The absolute level was decidedly less during the presence of the influenza epidemic than it was for the corresponding period of the previous year of 1942 (Figure 7, Table 7). Pneumonia cases were not only infrequent during the course of the influenza outbreak but no death from pneumonia secondary to influenza was specifically noted.

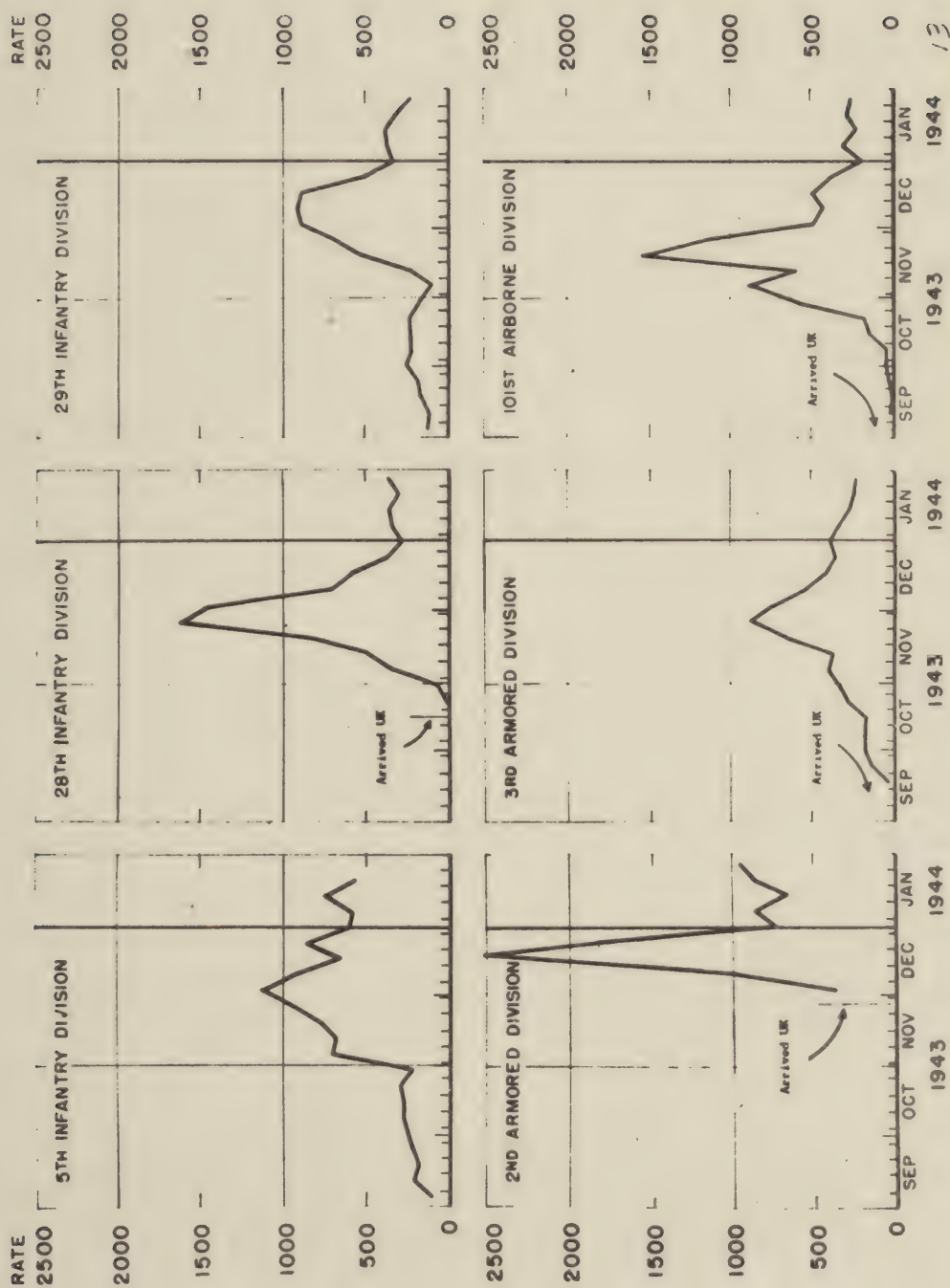


Figure 5. Common respiratory diseases including influenza, six selected divisions, European Theater of Operations, U. S. Army, admission rate per 1000 strength per annum, by weeks, 3 September 1943.





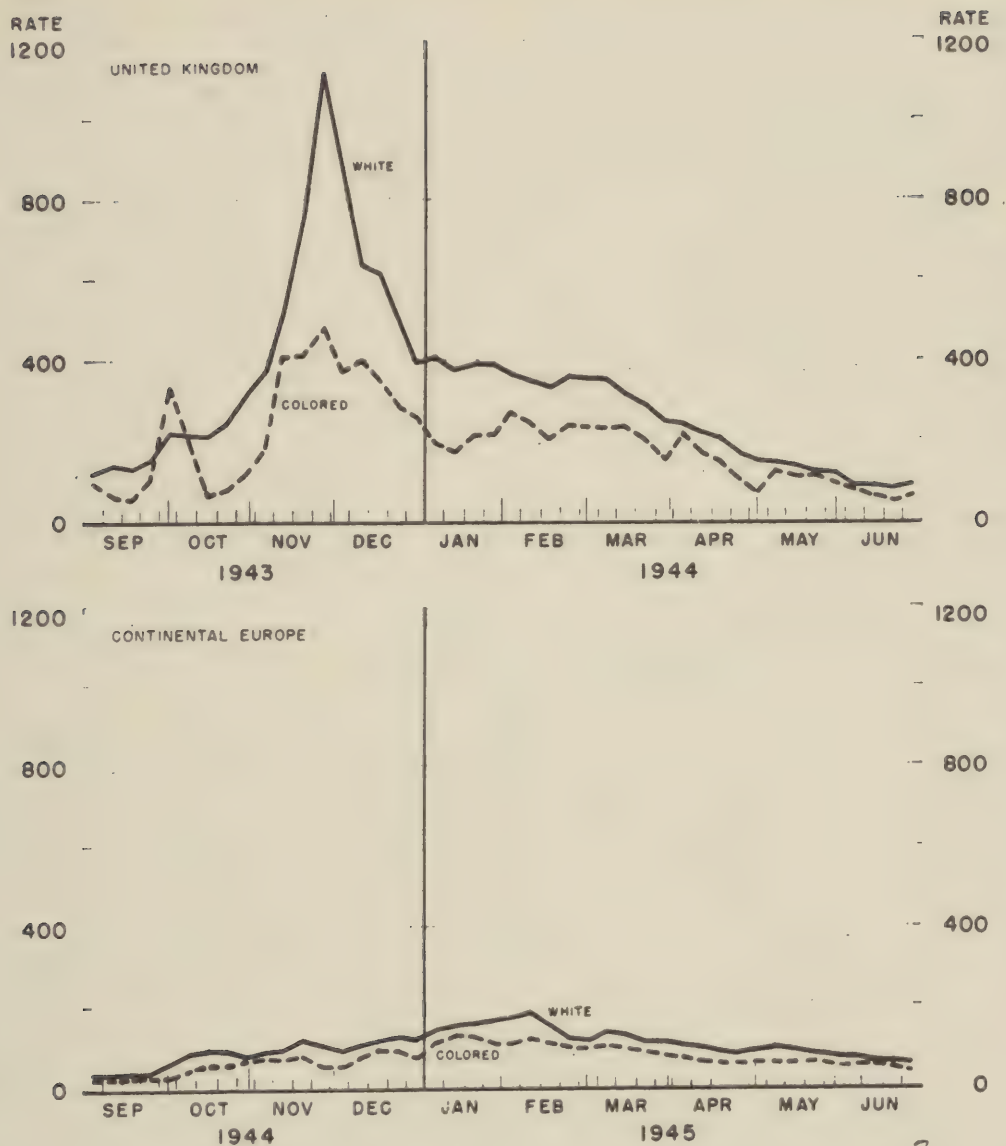


Figure 6

Common respiratory diseases including influenza, white and colored, European Theater of Operations, U. S. Army, admission rates per annum, by weeks, in United Kingdom, 3 September 1943 to 30 June 1944; and on Continental Europe, 1 September 1944 to 29 June 1945.



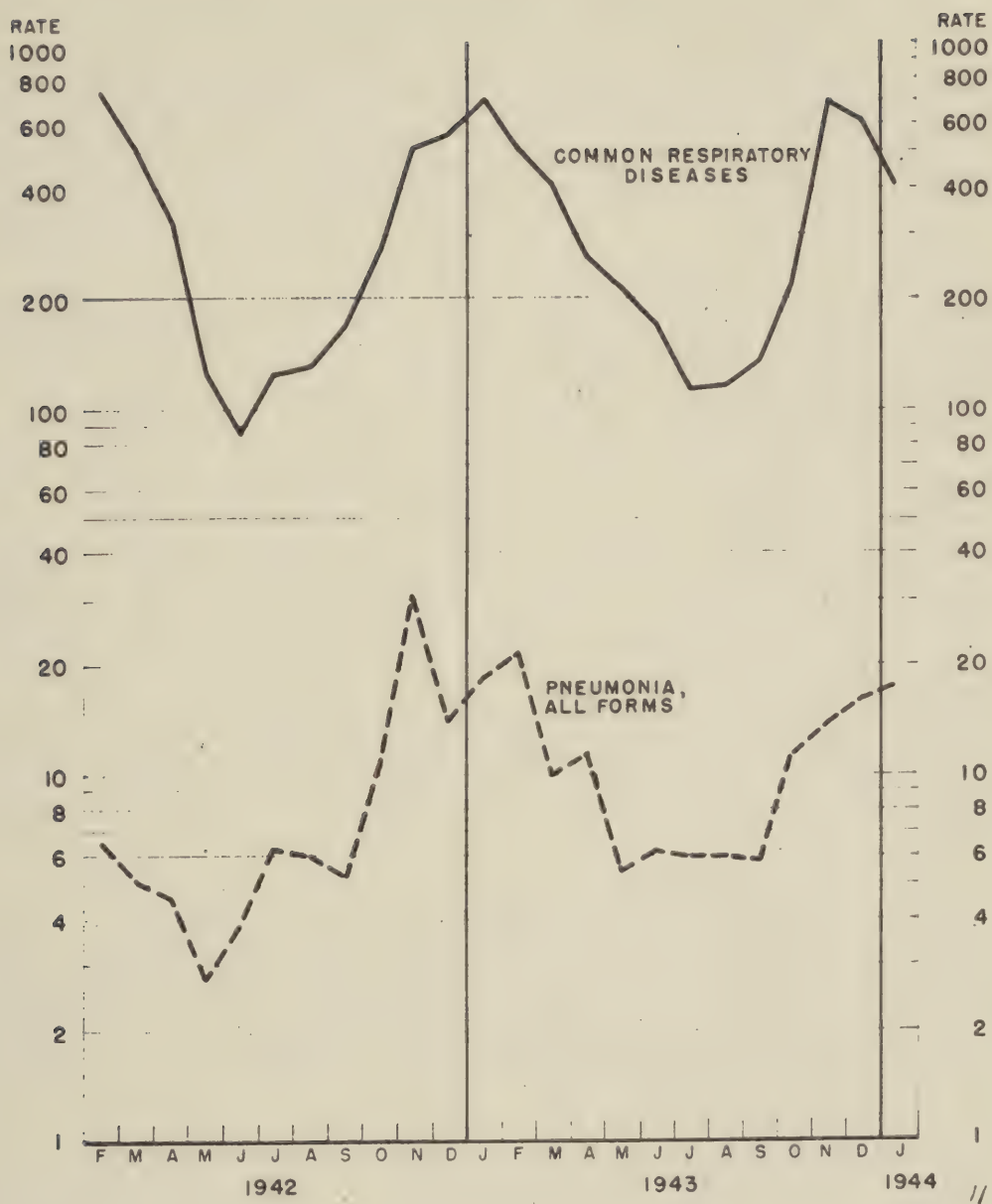


Figure 7

Common respiratory diseases including influenza and the pneumonias (all forms), European Theater of Operations, U. S. Army, comparative rates per 1000 per annum by months, February 1942 to January 1944.





Influenza in the British Civilian Population.--The experience of the British civilian population in this influenza epidemic differed from that of the United States Army principally in respect to mortality. The outbreak occurred at the same time, the clinical course was similar and the same type of influenza virus was demonstrated. Reliable information on morbidity was lacking but the infection was apparently as widespread and universal among civilians as it was among the military.

During September, the number of deaths from influenza for the 126 great towns of the United Kingdom, representing a population of about 21,000,000, was less than 10 per week. (Figure 8, Table 8.) A progressive increase in mortality rates from influenza became apparent during the next three weeks, with 106 deaths due to this cause reported for the week ending 20 November 1943. The maximum number of 1148 deaths was reached during the week of 11 December, which was two weeks later than the peak for reported cases among the American military forces. As the maximal frequency of deaths naturally follows the height of reported cases, the peak of case incidence among British civilians without doubt occurred at about the same time as that for the United States Army.

Deaths from influenzal pneumonia were largely among persons in the older age groups, and differences in population content account for the higher death rates among British civilians as contrasted with the United States Army which had a very favorable group of young adults.

Epidemic Influenza in Smaller Units of the U. S. Army.--The broad aspects of this epidemic have been described as they affected the military population of the United States Army as a whole. Equally informative information concerning the characteristics and behavior of the epidemic disease was obtained through consideration of the affect it had on individual and relatively small units.

No attempt was made to accomplish a general field survey of the outbreak. That is ordinarily productive of little result with influenza, because of the rapidity with which it travels and the short duration of a unit outbreak. Epidemiologic studies were limited to thorough observations of a few unit outbreaks. The purpose was conceived as wholly apart from control measures, the institution of which, in a widespread outbreak such as the one at hand, had of necessity to fall to unit surgeons. Epidemiologists of the theater were considered to have two obligations. The first was to determine the nature of the epidemic process and, secondly, to transfer this information to the surgeons of major commands with such recommendations for control as field studies indicated. It was believed the limited number of experienced epidemiologists could be most usefully employed in the manner indicated. A distinct regularity of epidemiologic pattern was demonstrated for outbreaks of respiratory disease in various units. (Figure 9, Table 9.)

Epidemiologic Case Report No. 1.--The outbreak of influenza among the Medical Department personnel of the 77th Station Hospital, located in the Eastern Base Section, began suddenly on 31 October 1943, reached a rate of 2,586 per thousand per annum for that week, and subsided rapidly during the following week. The symptoms were those of general malaise, coryza and congestion of nose and throat and fever of 100° F. for 48 to 72 hours. The duration of illness lasted from five to seven days. Two patients developed pneumonia.

Epidemiologic Case Report No. 2.--Two units of engineers, the 360th Engineer (GS) Regiment and the Second Battalion of the 358th Engineer (GS) Regiment, were stationed in the Eastern Base Section, lived in tents in the same vicinity, and worked on the same construction project. For all practical purposes they constituted one military population. The influenzal outbreak began on 8 November 1943, and the two units were equally affected. The highest level of incidence, 6,111 per thousand per annum was reached during the week of 26 November 1943. The decline of the outbreak was as rapid as had been its onset. The incidence was greater and the clinical disease more severe than for most other units of the Eastern Base Section. Symptoms consisted of general malaise to almost complete exhaustion, and temperatures ranged from normal to 104° F. with chills, generalized aching and conjunctivitis. Four to eight days was the average duration of the disease.

Epidemiologic Case Report No. 3.--The outbreak involved a newly arrived unit. The 333rd Engineer Regiment arrived in the United Kingdom on 21 October 1943, proceeded to the Southern Base Section, and immediately became engaged in construction work. On 30 October, the first cases of respiratory disease were reported. For the week of 19 November the admission rate was 3,807 per thousand per annum. This fell rapidly during the next three weeks. Ten of the patients were hospitalized for primary pneumonia, a possible contributing factor being a temporary shortage of outer clothing. The clinical features of what was called common respiratory disease were temperatures of 101° F. to 103° F., general malaise, and loss of appetite.

Epidemiologic Case Report No. 4.--The 342d Engineer Regiment by contrast with the Engineer unit mentioned just previously had been stationed in the United Kingdom for approximately 17 months and was likewise engaged in outdoor construction work. Influenza was first observed 12 November 1943. The



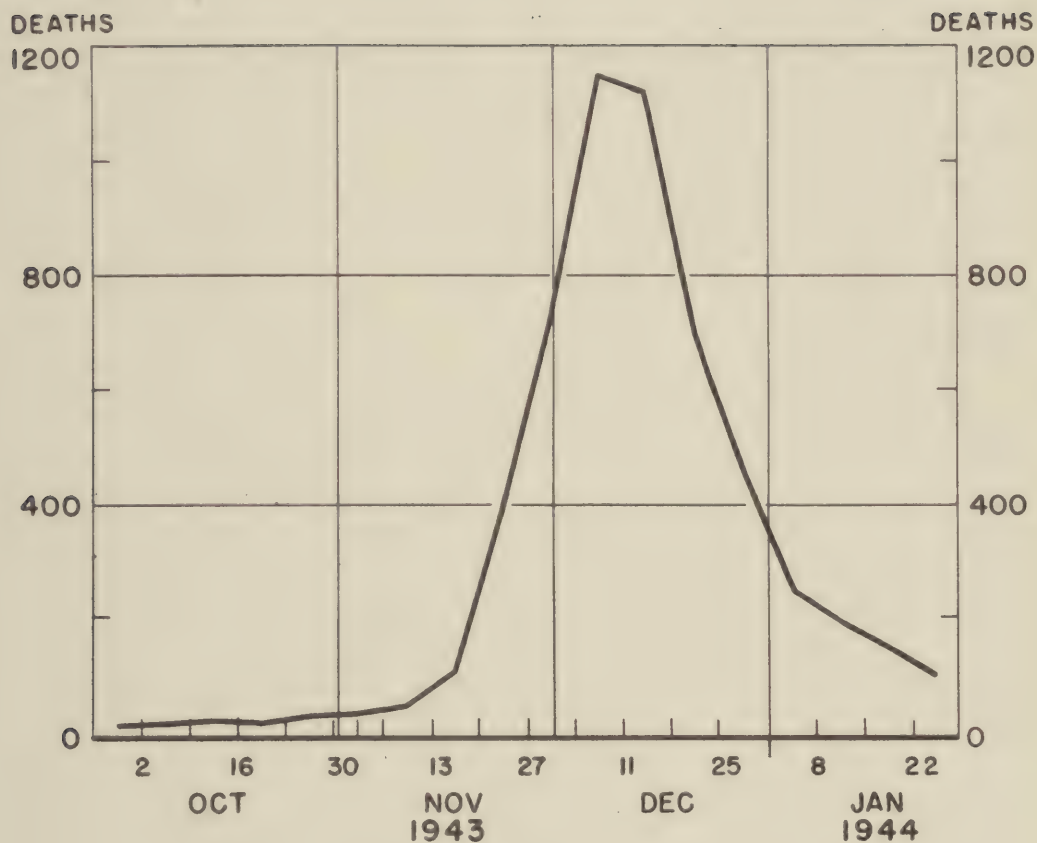


Figure 8

Influenza, 126 Great Towns, England and Wales, number deaths by weeks, 2 October 1943 to 29 January 1944.



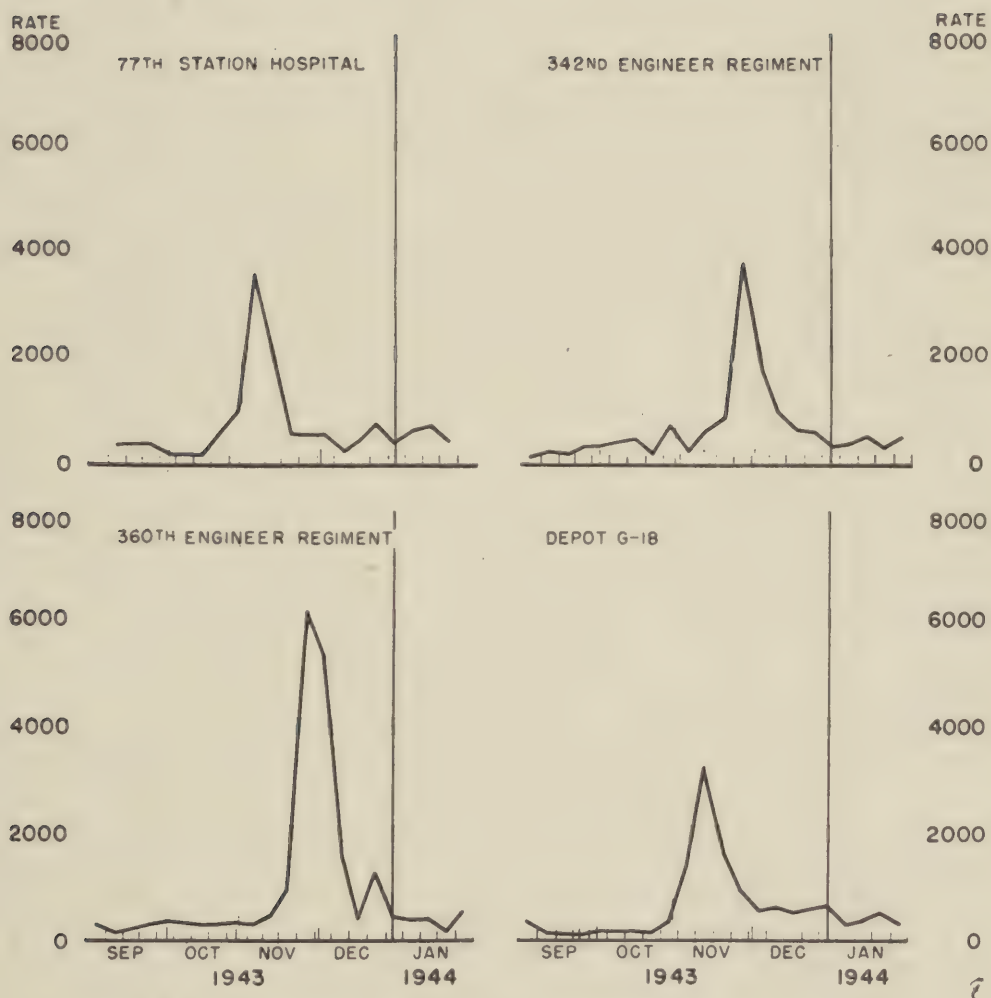


Figure 9

Common respiratory diseases including influenza, selected units, European Theater of Operations, U. S. Army, admission rates per 1000 strength per annum, by weeks, 3 September 1943 to 28 January 1944 inclusive.





rate of incidence rose sharply to reach 3,712 per thousand per annum for the week of 26 November. The clinical features were described as headache, malaise, prostration, occasional vomiting and diarrhea, minor upper respiratory symptoms and temperatures ranging from 100° F. to 103° F.

Epidemiologic Case Report No. 5.--General Depot G-18 of the Western Base Section had a strength of 5,737 men divided into eight camps. The first five were situated near Sudbury, England, and Nos. 6, 7, and 8 were at Eggerton, several miles away. On 3 November, the first probable patient with influenza from C Company, 131st Quartermaster Regiment (TRK), Camp No. 2, reported to the dispensary with headache, backache, prostration, and an elevated temperature. Within 12 hours, the medical officer developed the same symptoms. The following day 21 men of C Company were ill. On 5 November, cases began to develop in the 445th Engineer Base Company, on 7 November in 608th Engineer Light Equipment Company, and on 8 November in the 887th Ordnance Ammunition Company. Altogether, Camp No. 2 with 837 men had 121 patients in hospital with influenza, practically all of whom developed the infection between the 4th and 11th of November and belonged to one or other of the four companies noted.

Camp No. 1 was located in the same vicinity as Camp No. 2, and shared the same dispensary. The outbreak in this camp extended over the same period. Of 849 men, 72 were admitted to hospital with influenza.

Camp No. 3, housing the 534th Quartermaster Service Battalion, a colored labor unit, had no known association with any other camp except for an exchange of labor with the 2d platoon of D Company located at Camp No. 8. The outbreak of influenza began at Camp No. 3 on 14 November with the hospitalization of six men. The following day so many new cases appeared that two empty barracks were converted into a camp infirmary. During the period 14 to 24 November, this unit had 111 cases of respiratory disease. The infection spread to 2d platoon, D Company at Camp No. 8 and 26 cases were reported between the 22d and 25th of November. With the exception of this platoon there were few cases of respiratory infection at Camp No. 8.

Camp 4, with 689 men, sent 15 to the hospital between 17 November and 25 November, and the daily sick call averaged about 15 which was only slightly higher than had held in October.

Camp 5, an Air Corps Depot having little association with other camps, had no cases of influenza.

Camps 6 and 7, located several miles from the other camps, likewise had very few cases of respiratory disease.

It is clearly demonstrated that respiratory disease spread rapidly from one group to another within an incubation period of about 24 to 48 hours. Association of groups was a much more important factor than kind of work or type of quarters.

Determination of the Specific Infectious Agent.--The specific etiologic agent involved in the 1943 epidemic was determined to be influenza virus Type A. Examinations of material for identification of the virus were obtained from patients in hospitals where continued observation permitted certain clinical diagnosis.

Instructions issued to hospitals stated that influenza viruses A and B were rapidly recognized by demonstrating a significant rise in specific antibodies in the serum of patients during convalescence. Antibodies which were normally present against these two viruses increased rapidly after infection and reached a maximum within several days. Therefore it was directed that an initial sample of blood serum be obtained promptly after onset of symptoms, and a second sample after six days. Estimation of influenza antibodies in single samples of blood was emphasized as being of no diagnostic value.

During the course of the epidemic somewhat more than 25 strains of Type A influenza virus were identified from patients of the theater. They were representative of the four base sections in Great Britain. No type B virus was ever found. The cause of the outbreak was thereby established as of uniform origin and of the type A variety. The first confirmation of virus was on 19 November 1943.

Influenza on Troop Ships.--Reports received from the United States gave information of an existing epidemic in the Zone of the Interior of type B influenza. There was considerable concern in Great Britain about the possibility of introducing this second strain of influenza virus, with superimposition of a second outbreak upon the first.

The convoy Ut-5 carrying approximately 63,750 troops on 24 transports, 17 from New York and 7 from Boston, departed for the United Kingdom on 5 December 1943. Respiratory disease was epidemic in the staging areas where these troops were held prior to sailing. The convoy arrived at four ports in the United Kingdom - Glasgow, Liverpool, Bristol, and Belfast -- between 15 and 17 December 1943. A member of the Division of Preventive Medicine was sent to each port to investigate conditions on the incoming transports.

The two or three days before sailing were spent in the checking of equipment and with matters concerned with embarkation.



This involved much waiting around, often in exposed situations and with little sleep. Troops arrived on board physically tired, they were packed below deck under overcrowded conditions, in some instances with double loading, and they sailed in early winter after exposure to an epidemic of influenza. Notwithstanding these factors, no unusual incidence of respiratory disease occurred.

Ships and port surgeons generally agreed that the cases which did occur did not exceed normal expectation for that season. A high proportion of troops did come on board with a respiratory infection of some sort -- according to the varied estimates of transport surgeons, in proportions of 15 percent to 80 percent. Many patients doubtless never bothered to go to sick call and yet figures showing the daily admissions to sick call throw several sidelights on the situation.

The greatest numbers of patients with respiratory illness were seen during the first half of the voyage, with the peak of the epidemic on the fourth or fifth day at sea. The number reporting to sick call with respiratory infection was 7,592 (11.9%) of whom 962 were hospitalized en route, and 86 evacuated to hospitals on arrival. For all transports, respiratory disease was less prevalent on debarkation than on embarkation. The actual incidence en route was less than that for most units stationed in the United Kingdom during the same period, and decidedly less than the observed rate for respiratory diseases on transports generally.

Three of the transport surgeons on ships leaving New York reported an outbreak of disease with the characteristic symptoms of influenza.

Epidemiologic Case Report No. 6.--The transport NY-613 carried 5,542 troops, an overload of 550. The ship surgeon reported that an outbreak of respiratory illness clinically suggestive of mild influenza occurred during the voyage. Treatment was given to 785 patients with respiratory disease and 58 were hospitalized, 36 with a diagnosis of nasopharyngitis, the remainder with bronchitis and pharyngitis, including three patients with pneumonia. Most cases occurred about five to six days after embarkation, the number decreasing rapidly thereafter. The daily sick call is presented in Figure 10, Table 10. The ship surgeon reported that on the whole the number of patients seen daily was no more than would ordinarily be expected on a transport traveling the north Atlantic at that time of the year. The general situation improved during the voyage. Four patients were disembarked for further treatment in hospital.

A small number of patients with an influenzalike disease was reported on other transports. There was a slightly higher proportion of respiratory disease among troops from New York than those from Boston, but the difference was not striking. The largest transport of the convoy, the BO-454 came from Boston. According to the ship surgeon there were very few infections from this port suggestive of influenza. For the most part symptoms consisted of aching joints and muscles, congestion of mucous membranes and a temperature of 102° F. to 104° F. A relatively small number developed pneumonia. One transport surgeon, the only medical officer aboard his ship, died of pneumonia.

The circumstances under which this large convoy sailed aroused concern on both sides of the Atlantic. Troops left the Zone of the Interior where influenza was epidemic, the incidence among embarking troops was high, the crowded conditions favored a serious outbreak during the course of the voyage. From the standpoint of the theater, there was danger of introducing a new strain of virus into a population where influenza was already epidemic. Essentially nothing happened. The health record of the troops in respect to respiratory disease was better than usually experienced. There was no evidence at the time, nor later, that type B influenza virus was ever introduced into Great Britain by recently arrived United States troops.

Program of Control.--The principle was early referred to medical officers of the theater that actual control of epidemic influenza in the sense of inhibiting or arresting its spread was beyond the capacity of present day methods, but that preventive measures were of decided value in checking the explosiveness of the epidemic spread. Retardation of the rate of spread could be expected to produce results leading to fewer men being incapacitated at any one time. The work of a unit would consequently be interfered with to a lesser extent, hospitals would not be overloaded, and patients would receive better care. The total number of cases could be expected to be less than otherwise.

The program instituted to attain this end included provision for epidemiologic studies of isolated outbreaks, that surgeons of the theater might be informed of the current clinical and epidemiologic nature of the condition, the extent of its existence in the theater and the anticipated future behavior of the epidemic. Sufficient laboratory examinations were instituted to establish the nature of the infectious agent, its presumed unity throughout the theater, and the extent of the distribution of the virus.

Actual control measures for units of the theater were designated a responsibility of command, with the assistance of unit surgeons. The functions of the central Division of Preventive

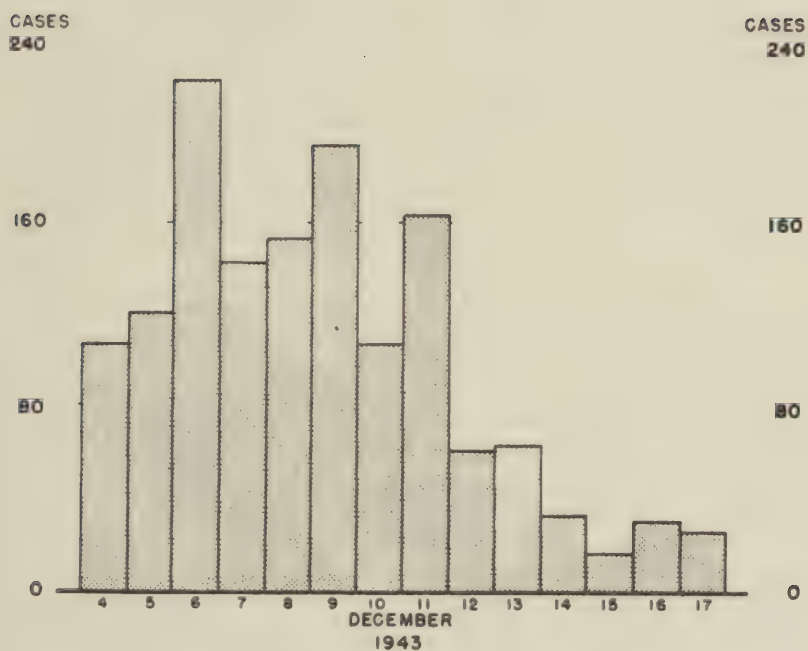


Figure 10

Daily sick call of patients with acute upper respiratory infection on board Transport NY 613 "Britannia", December 1943.





Medicine were directed toward collection of information and its distribution to surgeons. Advice was given on control measures, based on accepted general principles. A general educational program was instituted through the army newspaper Stars and Stripes and for medical officers through the Medical Bulletin of the Office of the Chief Surgeon. The material directed attention to matters of personal hygiene, of sleeping arrangements, of mess kit washing and the numerous other features of a program for prevention of acute respiratory infections.

Special stress was placed on frequent medical inspection to discover the presence of upper respiratory disease among food handlers, with directions that persons so infected were to be assigned to other duty or isolated as the situation demanded. The existing blackout regulations interfered with proper ventilation. Full advantage was to be taken of all available means of ventilation with ventilators kept free of obstruction and windows opened at night. Barracks were directed to be freely aired during the day.

Working quarantine was stated to be impractical. No method existed for determining carriers and the results likely to be obtained from quarantine on an effective scale would interfere in too great extent with unit training activities. Troops should be kept fully occupied; the precautions outlined need not interfere with the activity of any unit as a whole. Mild cases were to be recognized as a potent source of spread of respiratory disease.

Instructions to medical officers stressed a variety of considerations. Daily medical inspection was emphasized as the only method of detecting early and mild infections. Patients were to be either specially instructed on precautions to be taken or isolated. If the fullest measures were not taken to insure proper isolation, patients admitted to a dispensary or infirmary were likely to contract a respiratory cross infection during their visit which was not present on admission. Care was necessary that all discharges from patients in an infirmary be burned or otherwise disinfected. It was urged that the diagnostic term influenza be used according to epidemiologic criteria and that it be limited to cases which were clinically typical and occurred in groups.

The Post Epidemic Period.--There was much speculation at the time of the 1943 epidemic of the possibility that this mild wave might be the precursor of an outstanding pandemic of influenza. A series of such events had preceded the last great epidemic in 1918, with the first of the preliminary waves in March, another in May and the main event in August. Although no reason existed for belief that the 1943 epidemic of type A influenza had any more relation to a future pandemic than any one of numerous others that had preceded it

in past years, the military implications of such an event were so important that full measures were taken to acquaint the command with that possibility.

Shortly after the epidemic wave had passed, a letter was sent by the Chief Surgeon to the surgeons of all major commands on the need for reporting subsequent recurrences of influenzalike disease. In February, 1944, the theater commander addressed all principal components of the American forces on measures to prevent epidemics of respiratory disease, in which it was brought out that the epidemic of mild influenza, which the army had recently experienced, should serve as a warning of the possible occurrence of a serious pandemic. The mildness of the disease in the past two years was not to give rise to a false sense of security since influenza epidemics with high mortality were frequently preceded by waves of mild influenza and it was entirely possible that this sequence would occur again. Special stress was placed on the considerations to be given housing, transportation, and the medical supervision of troops, especially those scheduled for operational movements.

This directive was followed some two months later by a comprehensive circular letter from the Office of the Chief Surgeon to all medical elements of the theater. The epidemiologic features of influenza in military populations were discussed and the possible intrusion of a second wave was again presented, together with the precautions necessary for protection of troops from this infectious disease. The unusual concern given the matter originated of course from the serious effect such an event would have had on preparations for the impending invasion of France.

Subsequent Behavior of Influenza.--Shortly after the end of the 1943 epidemic, a special organization was established to facilitate early recognition of a possible return of the disease. Through a cooperative effort of the First Medical General Laboratory, of the Division of Professional Services and of Preventive Medicine, a small group of qualified observers was selected, usually the chiefs of medical services in certain general hospitals, who were charged with special watchfulness for an epidemic disease suggestive of influenza; for reporting such possibilities to the Office of the Chief Surgeon; and for the collection and transmission of the necessary blood samples to be examined for the presence of antibodies to influenza virus. These special medical observers were so chosen as to give general coverage of the theater.

Nothing occurred throughout 1944 to suggest the presence of influenzal infection in the European Theater. The year was completely uneventful in respect to that disease, and in fact the general rate for respiratory infections was particularly favorable. The following spring of 1945 brought more cogent possibilities of influenza, although the early months of 1945 had been characterized



by particularly low rates for diseases of the respiratory tract. The minor outbreaks which had characterized the late spring months of 1943 might well be repeated in the light of the two-year cycle of Type A influenza.

In April of 1945, the first positive identification of influenza virus was made in Great Britain and during the same month the virus was also determined among troops stationed in Germany. These were the only two known instances. A limited number of small outbreaks confirmed the activity of the virus. The epidemic that involved the 794th AAA (AW) Battalion located in Speyer, Germany, was typical.

Epidemiologic Case Report No. 7.--A sudden outbreak of an acute febrile disease occurred in the 794th AAA (AW) Battalion which was encamped on the west bank of the Rhine, 15 miles south of Mannheim. The epidemic extended over a 12-day period, from 29 May 1945 to 9 June 1945, during which time 83 men were sent to hospital. The battalion had a strength of 780 men divided into five batteries. Batteries A, B, C, and D had a strength of 160 men each, and headquarters battery a strength of 100. The men were living under canvas. The clinical disease was marked by sudden onset of marked prostration followed by headache and pains in the neck, lumbosacral region and chest. This was accompanied by chills and fever, with temperatures averaging about 103° F. White blood counts showed a leukopenia ranging from 5,000 to 7,000 per ccm. The febrile period lasted about 7 days and continued after clinical improvement was apparent. There were no deaths. The original case, and the majority of those that occurred subsequently, involved men of C Battery. Each battery had its own mess, and association between the men in the several batteries was limited. Only after the fourth day did the epidemic spread to the other batteries and that never occurred to any appreciable extent. (Figure 11, Table 11.)

The epidemiological behavior of this outbreak of acute febrile disease was characteristic and typical of an outbreak of acute influenza. The clinical disease was of that nature. The etiologic agent remained undetermined since blood samples taken at the time never came to report.

Contrary to the experience of 1943, there was no perceptible increase of similar events in the course of the summer, and the autumn of 1945 passed with no indication of an undue prevalence of epidemic proportions throughout the winter of 1945-1946, although both types A and B influenza were demonstrated in Germany in that time.

Specific Prevention of Influenza.--The newly developed influenza vaccine of the United States Army Medical Department became available in late 1944. The supplies were so limited at that time that the product was never used to any appreciable extent in the European Theater, either in immediate immunization in the face of a developing epidemic of influenza nor in general protection of the command. Sufficient supplies for the first purpose were obtained early in 1945, but the absence of the disease obviated its use. Consideration of general immunization of the command was postponed until the following autumn, because of the considered inadvisability of a general program of immunization against influenza initiated in the spring months of a year when the disease was thus far absent.

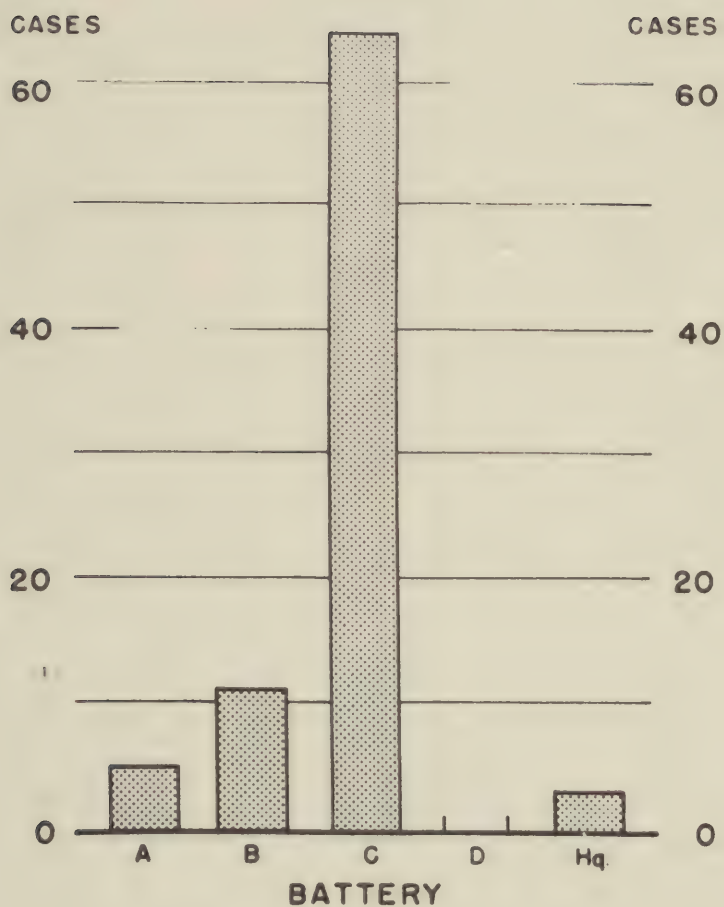


Figure 11

Acute upper respiratory infection, 794th AAA (AW) Battalion, European Theater of Operations, U. S. Army, number cases hospitalized, 29 May to 9 June 1945.





**TABLE I**

**Influenza**

**European Theater of Operations  
U. S. Army**

Cases and Rates per 1000 strength per annum, by years

February 1942 to June 1945, inclusive

Year	Cases	Rates
1942	1680	23.1
1943	3850	14.6
1944	3226	2.2
1945	2766	2.0
Total	11522	3.6

Source: Division of Medical Records, Office of The Surgeon General  
European Theater of Operations

TABLE 2

Common Respiratory Disease Including Influenza

European Theater of Operations

U. S. Army

Admission rates per 1000 strength per annum, by weeks

3 September 1943 to 28 January 1944, inclusive

Week Ending	Rate
1943, September 3	118
" 10	136
" 17	132
" 24	151
October 1	231
" 8	204
" 15	203
" 22	205
" 29	286
November 5	360
" 12	494
" 19	725
" 26	1079
December 3	829
" 10	626
" 17	591
" 24	493
" 31	387
1944, January 7	389
" 14	370
" 21	383
" 28	384

Source: Division of Medical Records, Office of the Chief Surgeon, European Theater of Operations



TABLE 3

Common Respiratory Disease Including Influenza  
Base Sections

European Theater of Operations U.S. Army

Admission rates per 1000 strength per annum, by weeks,

3 September 1943 to 28 January 1944, inclusive

Week Ending	Base Sections					
	ETO	Central	Eastern	South- ern	West- ern	North Ireland
1943, Sept.						
3	118	127	129	98	88	
10	136	186	134	101	110	
17	132	183	113	111	95	
24	151	218	143	137	114	
Oct.						
1	231	372	235	356	147	
8	204	312	221	169	130	221
15	203	146	253	149	158	82
22	205	236	269	160	168	61
29	286	266	265	383	243	167
Nov.						
5	360	402	344	389	365	220
12	494	807	593	408	626	289
19	725	1310	881	741	707	273
26	1079	1745	1438	1121	1001	584
Dec.						
3	829	1086	1110	905	669	765
10	626	819	666	657	455	589
17	591	645	505	568	427	504
24	493	672	471	433	359	366
31	387	491	392	374	307	265
1944, Jan.						
7	389	515	352	340	291	270
14	370	526	298	335	296	253
21	383	468	335	372	394	483
28	384	424	340	409	396	306

Source: Division of Medical Records, Office of the Chief Surgeon,  
European Theater of Operations.

TABLE 4

Common Respiratory Diseases Including Influenza  
Major Commands

European Theater of Operations

U.S. Army

Admission rates per 1000 strength per annum, by weeks  
3 September 1943 to 28 January 1944, inclusive

Week ending		Ground Forces	Air Forces	Services of Supply
1943	September 3	137	120	109
	10	153	144	118
	17	145	139	114
	24	166	148	139
	October 1	217	204	260
	8	201	*	*
	15	207	212	183
	22	147	236	197
	29	231	298	292
	November 5	354	357	358
	12	426	513	527
	19	679	688	775
	26	957	1009	1190
	December 3	840	727	890
	10	706	545	610
	17	785	473	523
	24	631	420	437
	31	406	369	368
	1944 January 7	401	378	344
	14	394	346	332
	21	366	360	386
	28	374	360	389

\* Data not available.

Source: Division of Medical Records, Office of the Chief  
Surgeon, European Theater of Operations

TABLE 5.

Common Respiratory Diseases Including Influenza  
Six Selected Divisions

European Theater of Operations

U. S. Army

Admission rates per 1000 strength per annum, by weeks  
3 September 1943 to 28 January 1944, inclusive

Week Ending	5th Infan- try	28th Infan- try	29th Infan- try	2d Arm- ored	3d Arm- ored	101st Airborne
1943, Sept. 3	91		104			
" 10	208		104			13
" 17	182		156		26	0
" 24	221		164		148	18
Oct. 1	247		260		182	39
" 8	273		208		169	39
" 15	273		221		156	143
" 22	302	11	229		281	178
" 29	228	55	161		337	569
Nov. 5	702	338	97		395	890
" 12	681	499	226		377	600
" 19	779	821	531		654	1549
" 26	950	1643	698		882	1126
Dec. 3	1131	1461	899	379xx	747	490
" 10	921	708	931	1021	537	420
" 17	655	588	902	2505	412	496
" 24	866	375	509	1825	354	383
" 31	612	284	325	733	382	189
1944, Jan. 7	593	346	362	868	330	305
" 14	759	354	374	658	277	212
" 21	571	304	317	858	231	187
" 28	*	371	222	960	231	246

\* Data not available.

xx First Report submitted in U. K.

Source: Division of Medical Records, Office of the Chief Surgeon,  
European Theater of Operations.



TABLE 6.

## Common Respiratory Diseases

European Theater of Operations, United Kingdom and Continent, U. S. Army  
 Comparison of admission rates per 1000 strength per annum, by weeks  
 White and colored in an epidemic and a nonepidemic period  
 1943-1944

Time Period	White			Negro			White		Negro	Ratio of Difference W/C
	Epi- demic	Normal	Dif- ference	Epi- demic	Normal	Dif- ference	Ratio	Ratio		
							Epidemic Normal	Epidemic Normal		
1st week 15 Oct. 1943	4.15			1.16			2.3		1.1	29.1
13 Oct. 1944		1.82	2.33		1.08	.08				
2d week 22 Oct. 1943	4.56			1.33			2.8		1.3	9.7
20 Oct. 1944		1.64	2.92		1.03	.30				
3rd week 29 Oct. 1943	6.15			2.24			4.4		1.7	3.2
27 Oct. 1944		1.41	4.74		1.32	.92				
4th week 5 Nov. 1943	7.26			3.40			4.5		2.5	2.7
3 Nov. 1944		1.63	5.63		1.35	2.05				
5th week 12 Nov. 1943	9.73			7.83			5.8		5.8	1.2
10 Nov. 1944		1.68	8.05		1.36	6.47				
6th week 19 Nov. 1943	14.35			7.98			6.3		5.6	1.8
17 Nov. 1944		2.26	12.09		1.42	6.56				
7th week 26 Nov. 1943	21.71			9.17			10.9		9.0	2.4
24 Nov. 1944		2.00	19.71		1.02	8.15				
8th week 3 Dec. 1943	17.12			7.12			9.9		7.3	9.8
1 Dec. 1944		1.73	15.39		.98	6.14				
9th week 10 Dec. 1943	12.21			7.62			6.3		5.6	1.6
8 Dec. 1944		1.94	10.27		1.36	6.26				
10th week 17 Dec. 1943	11.83			7.02			5.5		4.0	1.8
15 Dec. 1944		2.16	9.67		1.76	5.26				
Average	10.91	1.83	9.08	5.49	1.27	4.22	6.0		4.3	2.2

Source: Medical Statistics Division, Office of The Surgeon General,  
 Washington, D. C.

TABLE 7.

Common Respiratory Diseases Including Influenza, and  
the Pneumonias (all forms)

European Theater of Operations, U. S. Army  
Comparative rates per 1000 per annum by months,  
February 1942 to January 1944 inclusive

Month	Common Respira- tory Diseases	Pneumonias all forms
1942, February	739	6.5
March	523	5.1
April	324	4.6
May	126	2.8
June	83	3.9
July	125	6.3
August	131	6.0
September	170	5.3
October	272	10.5
November	514	30.2
December	566	14.0
1943, January	704	18.3
February	516	21.5
March	408	10.1
April	263	11.4
May	216	5.5
June	173	6.3
July	116	6.0
August	117	6.0
September	136	5.9
October	236	11.4
November	700	14.0
December	628	16.3
1944, January	416	17.5

Source: Medical Statistics Division, Office of  
The Surgeon General, War Department, Washington, D.C.

TABLE 8.

Influenza

126 Great Cities and Towns, England and Wales

Deaths by Weeks  
2 October 1943 to 29 January 1944

Week ending		Deaths
1943, October	2	12
	9	14
	16	18
	23	13
	30	25
November	6	31
	13	46
	20	106
	27	375
December	4	709
	11	1148
	18	1115
	25	699
1944, January	1	464
	8	255
	15	197
	22	143
	29	104
TOTAL		5474

Source: England and Wales, Weekly returns, Births, Deaths, Marriages and Infectious Diseases, Office of the Registrar General, British Ministry of Health.



TABLE 9.

Common Respiratory Diseases Including Influenza  
Selected Units

European Theater of Operations, U. S. Army

Admission rates per 1000 strength per annum, by weeks

3 September 1943 to 28 January 1944, inclusive

Week ending			77th Sta. Hosp.	33rd Engr. Regt.	342d Engr. Regt.	360th Engr. Regt.	General Depot G-18
1943	September	3			85	241	277
		10	305		174	121	114
		17	*		134	*	85
		24	371		224	243	81
	October	1	95		266	324	141
		8	*		*	*	*
		15	93		389	226	145
		22	529		115	226	104
		29	900	O**	632	302	293
	November	5	3586	1098	183	265	1439
		12	1954	1374	565	402	3255
		19	511	3807	792	952	1627
		26	442	2716	3712	6111	867
	December	3	455	2407	1714	533	471
		10	182	1185	930	1500	545
		17	368	1661	592	394	462
		24	648	1265	544	1238	501
		31	371	989	255	397	595
1944	January	7	558	0	287	339	222
		14	649	0	425	375	290
		21	361	0	199	170	482
		28	*	0	411	478	307

\* Data not available.

\*\* First report received.

Source: Division of Medical Records, Office of the Chief Surgeon,  
European Theater of Operations.

TABLE 10.

Daily Sick Call of Patients With  
Upper Respiratory Infection

On Board Transport NY613 "Britanic"

December 1943

Date	Cases
December 4	105
5	119
6	220
7	142
8	152
9	192
10	105
11	163
12	60
13	62
14	33
15	15
16	30
17	25

\* The number of individual patients for the period was 785.

Source: Division of Preventive Medicine,  
Office of the Chief Surgeon  
European Theater of Operations

TABLE 11.

Acute Upper Respiratory Infections  
794th AAA (AW) Battalion

Number of Cases Hospitalized, 29 May to 9 June 1945  
European Theater of Operations, U. S. Army

Batteries	Cases
Hq	3
A	5
B	11
C	64
D	0
Total	83

Source: Division of Preventive Medicine,  
Office of the Chief Surgeon  
European Theater of Operations.





## FIGURES

1. Common respiratory diseases including influenza, European Theater of Operations, U. S. Army, admission rates per 1000 strength per annum, by weeks, 3 September 1943 to 28 January 1944, inclusive.
2. Common respiratory diseases including influenza, Base Sections, European Theater of Operations, U. S. Army, admission rates per 1000 strength per annum, by weeks, 3 September 1943 to 28 January 1944, inclusive.
3. Geographic distribution of common respiratory diseases, U. S. Army in the United Kingdom, 3 December 1943.
4. Common respiratory diseases including influenza, major commands, European Theater of Operations, U. S. Army, admission rates per 1000 strength per annum, by weeks, 3 September 1943 to 28 January 1944, inclusive.
5. Common respiratory diseases including influenza, six selected divisions, European Theater of Operations, U. S. Army, admission rate per 1000 strength per annum, by weeks, 3 September 1943.
6. Common respiratory diseases including influenza, white and colored, European Theater of Operations, U. S. Army, admission rates per annum, by weeks, in United Kingdom, 3 September 1943 to 30 June 1944; and on Continental Europe, 1 September 1944 to 29 June 1945.
7. Common respiratory diseases including influenza and the pneumonias (all forms), European Theater of Operations, U. S. Army, comparative rates per 1000 per annum, by months, February 1942 to January 1944.
8. Influenza, 126 Great Towns, England and Wales, number deaths by weeks, 2 October 1943 to 29 January 1944.
9. Common respiratory diseases including influenza, selected units, European Theater of Operations, U. S. Army, admission rates per 1000 strength per annum, by weeks, 3 September 1943 to 28 January 1944, inclusive.
10. Daily sick call of patients with acute upper respiratory infection on board Transport NY 613 "Britanic", December 1943.
11. Acute upper respiratory infection, 794th AAA (AW) Battalion, European Theater of Operations, U. S. Army, number cases hospitalized, 29 May to 9 June 1945.





## TABLES

1. Influenza, European Theater of Operations, U. S. Army, and rates per 1000 strength per annum, by years, February 1942 to June 1945, inclusive.
2. Common respiratory diseases including influenza, European Theater of Operations, U. S. Army, admission rates per 1000 strength per annum by weeks, 3 September 1943 to 28 January 1944, inclusive.
3. Common respiratory diseases including influenza, Base Sections, European Theater of Operations, U. S. Army, admission rates per 1000 strength per annum by weeks, 3 September 1943 to 28 January 1944, inclusive.
4. Common respiratory diseases including influenza, major commands, European Theater of Operations, U. S. Army, admission rates per 1000 strength per annum, by weeks, 3 September 1943 to 28 January 1944, inclusive.
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6. Common respiratory diseases including influenza, United Kingdom and continent, European Theater of Operations, U. S. Army. A comparison of admission rates per 1000 strength per annum, by weeks, for white and colored in an epidemic and a nonepidemic period, 1943 - 1944.
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8. Influenza, 126 Great Towns, England and Wales, deaths by weeks, 2 October 1943 to 29 January 1944.
9. Common respiratory diseases including influenza, selected units, European Theater of Operations, U. S. Army, admission rates per 1000 strength per annum, by weeks, 3 September to 28 January 1944, inclusive.



## EPIDEMIOLOGIC CASE REPORTS

1. A local outbreak of influenza early in the 1943 epidemic of influenza involving a hospital staff.
2. Influenza of 1943 in an engineer unit.
3. Influenza in a unit newly arrived in the theater.
4. Epidemic influenza in a seasoned unit.
5. Spread of influenza by continuity.
6. Influenza outbreak on a troop transport.
7. Interepidemic influenza in 1945.





A HISTORY OF PREVENTIVE MEDICINE  
IN THE  
EUROPEAN THEATER OF OPERATIONS  
UNITED STATES ARMY  
1941 - 1945

PART III - Epidemiology

Section 3 - Acute Respiratory Infections

Number 3 - The Pneumonias

by

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## PART III

### Epidemiology

#### Section 3 - Acute Respiratory Infections

##### Number 3 - The Pneumonias

###### Primary Atypical Pneumonia, Etiology Unknown.

Interest and knowledge in this newly recognized respiratory infection had developed well before the onset of military operations in Europe. The disease had not been reported with great frequency in England, and there was considerable speculation among medical officers as to how great its importance would be among American troops stationed there. It soon became apparent that this infection was about as common in military practice in the United Kingdom as it had been in the United States, and that the disease also existed among the resident civilian population.

The exact frequency of the condition for the first six months of operations cannot be determined, because it was not reported separately until 1 July 1942. Thereafter, atypical pneumonia was recognized with increasing frequency; to such extent that for the last two years of the theater it was more commonly reported than primary lobar pneumonia. It easily constituted the most important problem among respiratory infections.

The increasing frequency with which atypical pneumonia was being reported led to a series of special epidemiological investigations on this subject during October of 1942. Studies of some fifteen units stationed in England demonstrated the existence of the disease, gave the suggestion that atypical pneumonia was of considerably greater frequency than indicated by formal reports, and was of fairly general distribution. Most medical officers were found to be familiar with the condition, and a goodly proportion of units gave a history of the existence of atypical pneumonia during the training period in the United States.

A meeting of theater medical officers on 7 November 1944 was devoted entirely to this subject and a board for its study appointed by the Chief Surgeon. This board met at irregular intervals, always with primary interest in atypical



pneumonia but eventually broadening its interests to a consideration of all acute communicable diseases of current interest. One of the first activities of the board was to formulate current opinion on atypical pneumonia and to outline methods for control, study and management.

An atypical pneumonia that occurred in sporadic and epidemic outbreaks was being increasingly recognized as a disease entity. Medical officers of the United States Army when confronted with patients afflicted with incapacitating respiratory illness had the obligation to differentiate this disease from other kinds of pneumonia. When the clinical evidence clearly warranted a diagnosis of primary atypical pneumonia, etiology unknown, such a diagnosis was to be made. The designation virus pneumonia was discouraged, since a virus had not been demonstrated as the causative agent and moreover the term was not descriptive. In all cases, the medical officer was required to make a careful differential diagnosis, utilizing such facilities as were available, to exclude influenza, acute catarrhal bronchitis, psittacosis, Q fever, pulmonary coccidiomycosis and bacterial pneumonia.

The statement which follows represented the theater attitude toward this communicable disease, and the policy and procedures which governed activity directed towards its control. This information was given wide circulation to medical officers of the theater.

Clinical Features.--Presumptive but not absolutely conclusive evidence indicates that the incubation period is rather long, 2-3 weeks. The onset of the disease is usually gradual, and when first seen, patients complain of malaise and occasionally mild headache. Chilly sensations may be noted, with moderate elevation of the temperature. Slight soreness of the throat may occur but this is not a feature of the disease. The majority of patients develop a dry cough early in their course, which usually becomes productive later in the disease. The sputum tends to be mucoid and tenacious, and if rusty or bloody is probably associated with a pulmonary condition distinct from primary atypical pneumonia. It should be noted that some patients may go through the entire course without producing any sputum and with only slight cough. This is infrequent, and characteristically a fairly severe, irritating cough is present. Sub-

sternal discomfort may be present in some cases, but true pleuritic pain is extremely uncommon. Herpes labialis is not a feature.

The majority of patients do not appear sick enough for hospitalization until 4-5 days after the onset of the disease. At the time of admission the pulse rate is not markedly accelerated and is disproportionately slow in comparison with the rise in temperature. The respiratory rate is only slightly increased or may be normal. Many of the patients show moderate prostration, but in general do not appear critically ill. Coryza is usually absent.

The soft palate and pharynx show only a slight degree of inflammatory reaction. Edema and hyperemia of the lymphoid tissue of the posterior pharynx may be present, but are not striking. Exudate is not present. The acute inflammatory reaction of the pharynx associated with influenza is conspicuously absent, nor are generalized edema and hyperemia present as in the case of common cold.

As a rule, abnormal physical signs over the lungs are of minor degree during the early stages and this finding is rather characteristic of the disease. In general, these consist of slight impaired resonance to percussion with a diminution in breath sounds, and occasional fine moist rales. Rarely are the signs of massive consolidation elicited. The process is most commonly localized to one or both lower lobes, although any portion of the lungs may be involved, and in certain cases a diffuse patchy process may be present throughout the lungs.

Frequently the real extent of the involvement is not apparent until a roentgenogram of the chest is made. As a rule, a more extensive process is revealed than is suspected from clinical examination. The involvement tends to be patchy, although in many instances the shadow is more uniform and resembles that seen in lobar pneumonia, except that the density is less. This



type of shadow may be due to pleural inflammatory reaction. In general, the process appears to extend outward from the hilum toward the periphery of the pulmonary fields, simulating the roentgenographic appearance of the lungs in psittacosis. In other cases the involvement does not extend outward from the hilum but may be diffusely scattered throughout the lungs and resemble the later stages of military tuberculosis. This is not an uncommon picture. The clinical differentiation, however, should not present any difficulty. Patients showing diffuse patchy involvement generally have a more prolonged clinical course than those in whom a localized process is present. When the cough becomes productive the physical signs may be more marked, with increase in the number of rales and the presence of coarse rhonchi heard over most of the chest. Sonorous and sibilant rales are heard at times.

Generally speaking, the white blood count is normal, particularly in the early stages of the disease, both in total number and in the differential count. In some patients, particularly after several days of the disease, there is a slight elevation of the leukocyte count, though rarely above 14,000 per cu. mm. Actual leukopenia may be observed infrequently.

Although early in the disease the sputum is mucoid, it may occasionally become purulent later on. Bacteriological examination of the sputum has not revealed pneumococci in significant numbers, but careful studies of the sputum should be made before ruling out pneumonia due to the common bacterial incitants.

Aside from the abnormal findings described above, the remainder of the physical examination is essentially normal. The course of the disease is variable. The majority of patients run a low grade fever for approximately one week, with defervescence by lysis. Cyanosis may be present in severely ill patients. The period of convalescence may be prolonged, with weakness and vasomotor instability for as long as



3-4 weeks. This delayed convalescence is out of proportion to the apparent severity of the disease. In occasional cases the acute course may last for as long as 2-3 weeks. Clinical relapse has been observed in rare instances shortly after patients first become ambulatory. The etiology of the disease is unknown.

Differential Diagnosis.--Difficulty should ordinarily not be experienced in differentiating primary atypical pneumonia of unknown etiology from acute influenza due to influenza virus Type A or Type B. In influenza the onset is acute, with a generalized aching and hyperesthesia, usually severe headache and decided prostration. Catarrhal symptoms are not pronounced although there is marked injection of the conjunctivae and nasopharynx; in addition, leukopenia is characteristically present.

Patients with bronchitis not on an allergic basis or not preceded by influenza or common cold, should be examined carefully for evidences of primary atypical pneumonia. In such cases it is advisable to obtain roentgenograms of the chest. It seems likely that a certain proportion of cases diagnosed as bronchitis are actually suffering from primary atypical pneumonia. Furthermore, it is by no means clear that the latter infectious process invariably proceeds to involve the parenchyma of the lungs, and certain patients may suffer from bronchitis without pulmonary involvement.

The differential diagnosis from psittacosis cannot be made on clinical grounds alone. In this specific disease process the diagnosis may be established by isolation of the infectious agent, or else by the demonstration that specific antibodies to the virus have developed upon recovery from the disease.

Q fever likewise cannot be differentiated on purely clinical grounds. The diagnosis in this case may be established by isolating the rickettsia responsible for the infection or by immunological studies.

Differentiation from pulmonary coccidioidomycosis can be made by specific clinical and laboratory reactions, if the test material is available.

The differentiation from bacterial pneumonia, whether of bronchial or lobar distribution, should cause no difficulty. For example, in primary atypical pneumonia the leukocyte count is normal, the pulse and respiratory rates are only slightly elevated, the physical signs over the lungs and roentgenograms of the chest do not coincide and the atypical pneumonia does not respond to the sulfonamide drugs.

Management of Hospital Cases.--All of the existing evidence indicates that sulfonamides are not effective in the treatment of atypical pneumonia. Moreover the unrestricted use of sulfonamides in conditions where they are not indicated carries with it the dangers of producing toxic effects, as well as of sensitizing individual patients to a drug which may subsequently be of vital importance. It follows, therefore, that where the attending physician feels reasonably certain that he is dealing with atypical pneumonia, chemotherapy should be withheld.

On the other hand it is extremely important not to withhold sulfonamides in any condition where their use may be of critical importance to the patient, and it is recognized that certain varieties of pneumonia of bacterial origin may at times simulate atypical pneumonia. This is true of some of the secondary pneumococcal bronchopneumonias, together with certain infections due to hemolytic streptococci, Friedlander's bacillus, staphylococcus aureus, and H. influenzae. It is further possible that atypical pneumonia may alter its fundamental character and take on a secondary bacterial component, something which up to this time has not occurred. Lastly, influenzal pneumonia of the type seen in 1918 might reappear, where bacterial infection of the lung was an extremely prominent feature. It follows that the bacterial flora of the sputum in cases of atypical pneumonia must be kept under steady surveillance in order that proper treatment may be instituted should the occasion warrant.



With these considerations in mind, the following guide to therapy of atypical pneumonia was suggested:

Sulfonamides will not be given in the ordinary case showing characteristic features. Sulfathiazole or sulfadiazine is to be given in full doses if the onset is very abrupt, if there is a sharp leucocytosis or if leucocytosis develops as the disease progresses, if the sputum contains a preponderance of a pulmonary pathogen, or if the course is prolonged and unfavorable. Generally speaking, the effect of adequate sulfonamide therapy should be almost immediately apparent, and if none is discernible in two to three days, the drug should be discontinued.

Pathologic Studies.--Whenever possible, careful pathologic studies should be made of the lungs in all cases of fatal pneumonia. This is of particular importance in lobar pneumonia, in the influenzal and measles pneumonias and in all primary atypical pneumonias of unknown etiology. One clean incision made through the lateral border of the lung to the hilus will enable the prosector to complete his gross examination, cut blocks for his own histologic examination and insure proper fixation of the whole lung.

Laboratory Diagnostic Methods.--Lacking knowledge of the etiological agent, the laboratory cannot make a positive diagnosis of atypical pneumonia, but laboratory methods may aid in differentiating other conditions.

Significantly increased numbers of leucocytes and an increased proportion of polynuclear cells suggest a pyogenic infection and usually constitute an indication for sulfonamide therapy. Blood cultures should be taken. They are without result in atypical pneumonia, but in conditions such as meningococcemia and early typhoid fever a positive result serves in distinguishing diseases clinically similar. If undulant fever is suspected, the laboratory should be so informed because special cultural methods must be employed. Sputum cultures are usually not helpful but should be employed if there is suspicion of secondary infection or pneumococcal pneumonia.



Attempts to isolate other viruses such as those of influenza or psittacosis, are not practicable as a routine procedure because of the number of animals required and the necessary time for identification. Should such viruses be found, notification will be given to medical officers. The same situation exists regarding serological studies for antibodies against viruses.

Reporting.--All Medical Officers rendering weekly statistical reports were required to report atypical pneumonia, etiology unknown, on the Weekly Statistical Report, M. D. Form 86 ab, separately from other types of pneumonia. Thus the second section of the weekly statistical report might have cases under one of three headings: pneumonia, primary; pneumonia, secondary; and pneumonia, primary, atypical, etiology unknown.

When three or more cases of primary atypical pneumonia occurred in any company or detachment of similar size in any one week, the surgeon responsible for the medical service reported the fact by telephone to the Office of the Chief Surgeon. Likewise, whenever three or more cases diagnosed as primary atypical pneumonia were admitted to any hospital in any one week from a company or detachment of like size, the commanding officer of the hospital notified the Office of the Chief Surgeon by telephone.

Incidence of Atypical Pneumonia.--While primary atypical pneumonia, etiology unknown, was a reportable disease in the United States Army from 2 March 1942, no case was included in statistical reports of the European Theater until July of that year (Table 1). The number of cases increased during the autumn months but there was good reason to believe that reported cases never approximated the number actually existing, viewed in the light of the average rate that was maintained in subsequent years. The morbidity rate in 1942 was 2.5 per thousand per annum, in 1943 it was 6.1 and succeeding years had rates of 5.1 and 7.5.

The seasonal distribution of atypical pneumonia was regularly marked by rather sharp increases in October. Rates ordinarily continued at an excess level over average annual experience for the next several months, in general through May. The months of maximum prevalence were February and March. The highest incidence for any single month of the theater was in March of 1945, when the rate was 9.7. In number of cases and in attack rates, primary atypical pneumonia exceeded primary pneumonia (Table 2). The distinguishing feature between these two conditions was the tendency of atypical pneumonia to be well

maintained through the summer months, in contrast to the marked summer and winter variations of ordinary primary pneumonia.

Primary atypical pneumonia in the European Theater, like primary lobar pneumonia, was somewhat less frequently observed condition than among troops of the United States Army stationed in continental United States (Figure 1), Table 3.

Mortality.--Primary atypical pneumonia is recognized as an acute infection associated with a low death rate. Nevertheless, during the course of the four years of the European Theater, the number of reported deaths was 41 among 19477 recorded cases of the disease, a mortality rate of .013 per thousand per annum for the complete experience. The distribution of deaths by years is shown in Table 4. In general, the distribution of deaths was that of reported cases, in that years with a high case rate were characterized by excess mortality. In a number of instances, supposedly fatal cases of primary atypical pneumonia were known not to have been confirmed at autopsy. The corrected data are not yet available, and the rates cited are based on the usual figures from the Statistical Health Report. Deaths shown in this analysis are believed to be in excess of fact.

Increased Prevalence in 1944.--The strongly evidenced increase in admission rates for the pneumonias during the first three months of 1944 led to a special investigation of probable attendant causes, to the end of determining whether the increased frequency was primarily due to one or other of the two principal components of the pneumonia group, or whether both atypical and primary pneumonia were involved as the data seemed to indicate.

When comparison was made of the incidence of primary pneumonia and primary atypical pneumonia in the European Theater in the spring months of previous years with that of the spring of 1944, a sharp increase in the incidence of both diseases was noted in January, 1944, and becoming more apparent in March (Tables 1 and 2). It was further observed that no increased incidence of the common respiratory diseases nor of influenza had occurred, such as commonly precedes a greater reported frequency of primary pneumonia. (Table 3. Section 3, Part 1). While the increase in the pneumonias was not alarming, as can be seen by comparing the rates in the European Theater with those then current in continental United States, (Figure 2, Table 5), information was desired on whether or not any unusual factors had been introduced.



Since primary atypical pneumonia and primary pneumonia were apparently occurring in greater numbers at the same time, an effort was made to appraise the evidence for each patient, to the end of determining the accuracy of diagnosis. The differentiation of primary pneumonia and atypical pneumonia is often difficult as had been brought out in previous discussion. All clinical observations for a given patient were reviewed with the attending medical officer, and usually with the chief of the medical service of the hospital concerned. An agreement was reached as to whether what had been established as the final hospital diagnosis was to be considered confirmed, only probably confirmed, or remaining indefinite. Complete data were obtained for 75 patients.

In attempting to arrive at an accurate diagnosis, all the features exhibited by the patient during the entire course of illness were considered together. On this basis, and with these methods, it was possible to substantiate the hospital diagnosis of atypical pneumonia for 72 percent of the patients considered originally to have had that form of infection. In only 35 percent of patients determined by hospital physicians to have had primary pneumonia was the evidence considered adequate to justify the diagnosis. Bacteriologic confirmation was lacking for 66 percent of the cases considered to be primary pneumonia. In those instances where sputum cultures had been made, only one-half contained an organism which could be considered as the cause of the pneumonia. Attending physicians were of universal agreement that only a small proportion of the pneumonias that they had reported as primary pneumonia were of the classical lobar type, and only about ten percent contained typed pneumococci in the sputum. The uncomplicated atypical pneumonias were found to be classical in clinical manifestations and indisputably instances of that disease.

A comparison of the incidence of primary pneumonia and of atypical pneumonia in the European Theater revealed a parallel trend, which suggested common influences.

Epidemiologic information obtained by interview of patients in the course of visits to hospitals demonstrated that the pneumonias showed no tendency to occur with any special frequency among troops recently arrived in the United Kingdom. The average residence of patients in the United Kingdom was about six months antecedent to the onset of pneumonia. The patients with atypical pneumonia tended to remain longer in quarters or at work (3.8 days) before admission to hospital than those suffering from primary pneumonia (1.5 days). Outdoor



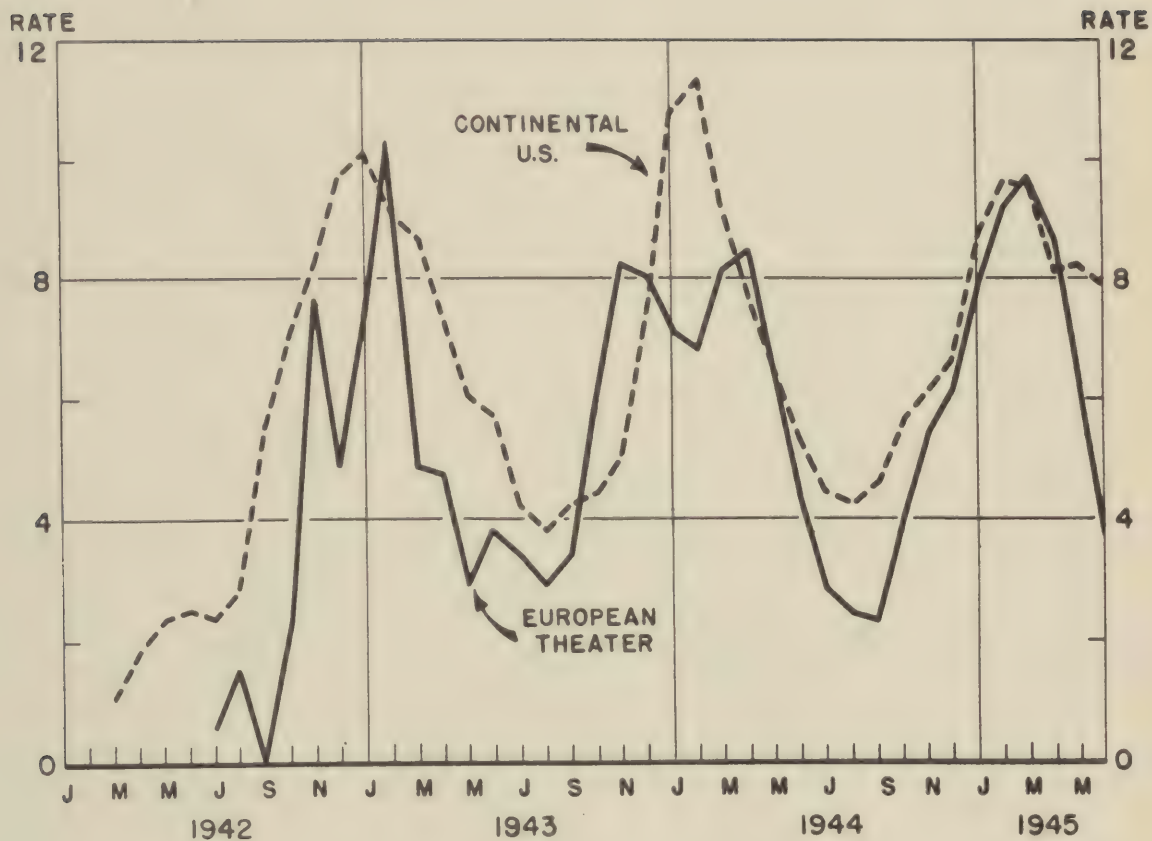


Figure 1. Primary Atypical Pneumonia, etiology unknown, European Theater of Operations and Continental United States, U.S. Army, admission rates per 1000 strength per annum.









versus indoor life seemed to be an insignificant factor. Exposure to chilling was claimed by only 40 percent of the patients. Only eight knew of any contact with others with pneumonia before they acquired the disease.

Bacteriologic information regarding the sputum of patients with the pneumonias was found to be meager. No culture of the sputum had been made in 41 percent of the primary pneumonias and none in 70 percent of the atypical pneumonias. Of the sputums cultured in the primary pneumonia group, only one-half gave morphologic evidence of pneumococci and only three were confirmed by typing. Of the sputums cultured in the atypical pneumonia group one-half had a predominating pathogenic organism, none of which were typed pneumococci. Further information was sought through information of sputums received at the First Medical General Laboratory for culture and typing. Pneumococci were primarily of Types 1, 2, and 3. The striking feature was that half of the specimens that were received contained a pneumococcus that could not be typed and only one such sputum had the classical features of being purulent and of rusty color.

The apparently increased incidence of both primary and atypical pneumonia in the absence of a corresponding increase in common respiratory disease could be interpreted as resulting from an actual increase in atypical pneumonia with an associated common confusion in diagnosis leading to many cases being reported as primary pneumonia. A number of considerations supported this hypothesis.

Detailed and careful clinical examination of representative patients in hospitals led to a confirmation of the diagnosis of atypical pneumonia in 72 percent of cases, but only 35 percent of supposed cases of primary pneumonia could be confirmed. The sputum in atypical pneumonia frequently changes in appearance from mucoid to mucopurulent as the disease progresses and the number of leucocytes may exceed 10,000. If the patient was first seen at that stage, or was finally considered in the light of such appearances, the mistaken diagnosis of primary pneumonia could readily be made. The apparently increased numbers of primary pneumonia occurred simultaneously with an undoubted increase of atypical pneumonia, and did not follow the upward swing of atypical pneumonia as would be expected if secondary infection was producing an ultimate primary pneumonia in an appreciable part of patients with an original primary atypical pneumonia. Bacteriological confirmation of most of the supposed primary pneumonias was lacking. Epidemics of atypical pneumonia occur at all seasons of the year and are not necessarily preceded or associated with an increase in common respiratory

diseases. The paradox of no increase in common respiratory disease and an increase in primary pneumonia would thus be dissolved. If it be granted that only 35 percent of diagnoses of primary pneumonia were correct, the incidence of primary pneumonia would then coincide with the recorded incidence in the European Theater during the preceding two years.

Another possible hypothesis was that an actual outbreak of atypical pneumonia occurred, in which contrary to previous experience a considerable number of patients became infected with secondary bacterial invaders. Suggestive evidence supporting that possibility was that 77 percent of the patients diagnosed as primary pneumonia experienced a prompt subsidence of symptoms when sulphonamides were administered, although only 35 percent of patients had enough features of primary pneumonia to justify the diagnosis. Response to sulfonamides alone is a poor basis on which to establish a diagnosis, as the temperature in atypical pneumonia falls at such varying periods as to easily permit confusion. The bacteriological data indicate the presence of a considerable number of pneumococci, some of which were non-typable, in the sputum of both forms of pneumonia.

Theoretically, an unusual number of patients with atypical pneumonia could have become secondarily infected through an existing greater prevalence of primary pneumonia, or by reason of a prevailing form of unusual throat pathogen; but reasonable evidence to support either possibility was not at hand.

The conclusions derived from these clinical and epidemiological studies were that an increased incidence of atypical pneumonia occurred in the European Theater during the early spring months of 1944. The apparent increase in primary pneumonia coincident with the increase in atypical pneumonia was believed most likely related to difficulty in differentiating the two types of pneumonia, with a tendency for many atypical pneumonias to be reported as primary pneumonia. The possible existence of an unusual secondary infection of atypical pneumonia has decidedly less support. The evidence is inadequate to eliminate with absolute conclusiveness an increase in primary pneumonia during the period concerned. The reported incidence of both types of pneumonia returned to a level of expected frequency in April. No satisfactory explanation for the outbreak was determined.

Atypical Pneumonia in the United Kingdom and on the Continent.-- The increased rates for atypical pneumonia for the year 1945 raised the question of whether or not the increase was due to a greater frequency of that infectious disease on the continent, as



compared to the United Kingdom. The relative frequency of the disease in the two parts of the theater during the period of active operations is presented in Table 6. The data show that during the period considered, the level of infection was measurably higher, 7.1 per thousand per annum in the United Kingdom, than it was on the continent, 5.7 per thousand per annum. The increased theater rates for 1945 were due to a greater level of reported cases from both Continental and United Kingdom areas in the late spring months of that year.

Primary Pneumonia.--Primary lobar pneumonia was never the problem in the European Theater that it was in continental United States. The comparative rates for troops of the two localities for pneumonia of all forms, including primary, secondary and atypical, during the four years of operations are shown in Figure 2. Information on primary pneumonia alone to permit direct comparison is not available for the Zone of the Interior.

The first year of experience in the theater, 1942, gave the highest rate for primary pneumonia of any of the four years of military operations in Europe, with 8.7 per thousand per annum. This is believed to have been influenced in part by the inclusion within reported cases of primary pneumonia, of appreciable numbers of primary atypical pneumonia, etiology unknown. Reporting of the latter condition was only practiced for a part of the year, and during that time was below the level that subsequent experience showed to be usual. An additional consideration was that housing and living conditions did not offer generally the same standards of accommodation as were later attained. The rates for diarrheal disease and a number of other infectious processes were higher that year than in subsequent experience.

Each year thereafter saw a progressively improved performance in respect to primary pneumonia, taking into consideration attendant circumstances. Specifically, the essentially equal rates of 1944 and 1945 are judged to qualify in that generalization, since the Armies were then in the field under campaign conditions, taking part in as active a winter operation as a United States Army had ever been called upon to face. The pneumonia rates were never better than they were in the months that followed the invasion of Normandy. (Table 2) Again there is evidence of the health that attends an army in the field, given the advantages of sound environmental hygiene. The record was all the more remarkable in view of the evidence brought out by the special study just presented, which indicated in all likelihood that a goodly proportion of patients considered to

have contracted primary pneumonia actually were suffering from primary atypical pneumonia.

The seasonal distribution of primary pneumonia met the usual expectancy of major predominance in the months of January, February and March; with January invariably showing the highest rates.

The mortality from the pneumonias was likewise low. Figure 3, Table 7 shows the rates for the Zone of the Interior and for the European Theater for primary and secondary pneumonias, and for primary atypical pneumonia. Deaths and death rates for primary pneumonia alone are presented in Table 8, by years, for the European Theater. The average death rate for the four years was .02 per thousand per annum, and for individual years it followed the number of reported cases.

Secondary Pneumonia.--Secondary pneumonia exercised such a minimal influence on theater disease rates as to constitute a truly remarkable phenomenon. The consistent and continued absence of measles, serious influenza, and similar diseases commonly attended by a complicating secondary pneumonia, was the evident explanation. The monthly distribution of cases is set forth in Table 9. Deaths from this cause are included with those from primary pneumonia.

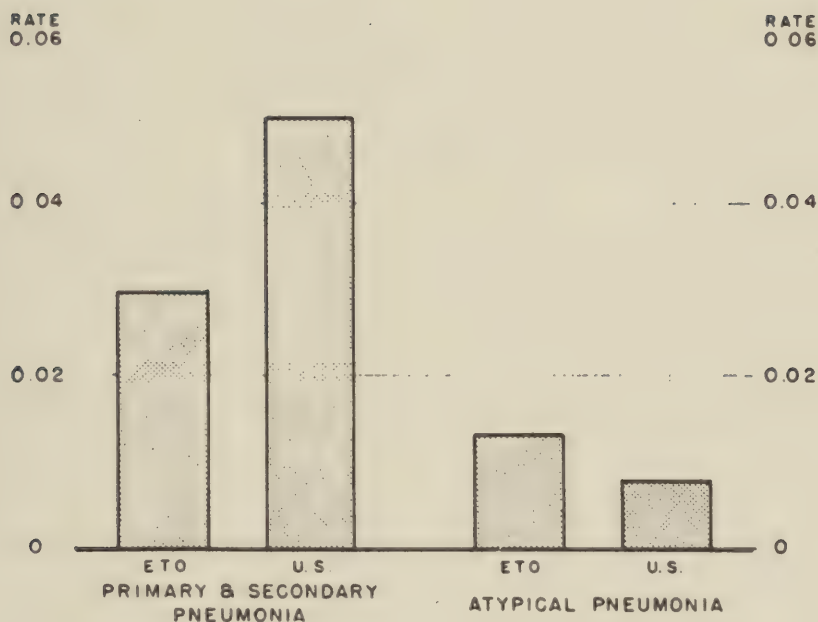


Figure 3. Primary and Secondary and Primary Atypical Pneumonias, European Theater of Operations and Continental United States, U.S. Army, mortality rates per 1000 strength per annum for period January 1942 to June 1945, inclusive.





Table I

## Primary Atypical Pneumonia, Etiology Unknown

## European Theater of Operations, U. S. Army

Cases and rates per 1000 strength per annum, by months

February 1942 - June 1945 inclusive

Month	Total		1942		1943		1944		1945	
	Cases	Rates	Cases	Rates	Cases	Rates	Cases	Rates	Cases	Rates
January	2062	7.7	*	*	80	7.3	439	7.1	1543	7.9
February	2457	8.6	*	*	87	10.3	476	6.8	1894	9.2
March	3435	9.1	*	*	40	4.8	834	8.1	2561	9.7
April	2700	8.4	*	*	50	4.7	778	8.4	1872	8.6
May	2063	6.2	*	*	27	2.9	656	6.5	1380	6.2
June	1562	3.8	*	*	46	3.8	542	4.3	974	3.7
July	376	2.8	3	.5	65	3.4	308	2.8		
August	377	2.4	13	1.5	57	2.9	307	2.4		
September	463	2.3	0	0	79	3.4	384	2.3		
October	804	4.2	38	2.3	221	6.0	545	3.9		
November	1238	6.1	85	7.6	337	8.2	816	5.4		
December	1940	6.4	45	4.8	522	8.0	1373	6.1		
Total	19477	6.1	184	2.5	1611	6.1	7458	5.1	10224	7.5

\*Data not available

Source: Division of Medical Statistics, Office of The Surgeon General, War Department, Washington, D. C.

Table 2

Primary Pneumonia

European Theater of Operations, U.S. Army

Cases and rates per 1000 strength per annum, by months

February 1942 - June 1945 inclusive

Month	Total		1942		1943		1944		1945	
	Cases	Rates	Cases	Rates	Cases	Rates	Cases	Rates	Cases	Rates
January	1712	6.4			116	10.6	613	10.0	983	5.0
February	1596	5.6	0	0	94	11.1	449	6.4	1053	5.1
March	1956	5.2	3	3.8	41	4.9	886	8.6	1026	3.9
April	1392	4.3	4	4.6	67	6.3	612	6.6	709	3.2
May	1165	3.5	6	2.8	23	2.4	490	4.9	646	2.9
June	705	1.7	14	3.9	28	2.3	292	2.3	371	1.4
July	235	1.7	37	5.8	46	2.4	152	1.4		
August	252	1.6	37	4.2	57	2.9	158	1.2		
September	300	1.5	65	5.1	57	2.4	178	1.1		
October	590	3.1	137	8.2	190	5.2	263	1.9		
November	815	4.0	246	22.1	217	5.3	352	2.3		
December	1328	4.4	80	8.6	511	7.9	737	3.3		
Total	12046	3.8	629	8.7	1447	5.5	5182	3.5	4788	3.5

Source: Division of Medical Statistics, Office of The Surgeon General, War Department, Washington, D.C.



Table 3

## PRIMARY ATYPICAL PNEUMONIA, ETIOLOGY UNKNOWN

European Theater of Operations and Continental United States  
U. S. Army, Admission rates per 1000 strength per annum, by months  
February 1942 to June 1945 inclusive

Year	Month	Continental United States	European Theater of Operations	Year	Month	Continental United States	European Thea. of Operations
1942	February	0	*	1944	January	10.8	7.1
	March	1.0	*		February	11.3	6.8
	April	1.8	*		March	9.3	8.1
	May	2.3	*		April	7.6	8.4
	June	2.4	*		May	6.5	6.5
	July	2.3	.5		June	5.3	4.3
	August	2.8	1.5		July	4.4	2.8
	September	5.5	0		August	4.2	2.4
	October	7.0	2.3		September	4.5	2.3
	November	8.2	7.6		October	5.6	3.9
	December	9.7	4.8		November	6.1	5.4
					December	6.6	6.1
1943	January	10.1	7.3	1945	January	8.7	7.9
	February	9.1	10.3		February	9.6	9.2
	March	8.7	4.8		March	9.5	9.7
	April	7.2	4.7		April	8.1	8.6
	May	6.0	2.9		May	8.2	6.2
	June	5.7	3.8		June	7.9	3.7
	July	4.2	3.4				
	August	3.8	2.9				
	September	4.2	3.4				
	October	4.4	6.0		Mean	6.4	6.1
	November	5.0	8.2				
	December	7.5	8.0				

\*Data not available.

Source: Division of Medical Statistics, Office of the Surgeon General,  
War Department, Washington, D. C.

Table 4

Primary Atypical Pneumonia, Etiology Unknown

European Theater of Operations, U. S. Army

Death and Rates per 1000 strength per annum, by years

February 1942 to June 1945 inclusive

Year	Deaths	Rates
1942	0	0
1943	0	0
1944	8	.0054
1945 Jan. - Jun	33	.0241
Total	41	.0129

Source: Division of Medical Statistics, Office  
of The Surgeon General, War Department,  
Washington, D.C.

Table 5

## THE PNEUMONIAS, ALL FORMS

European Theater of Operations and Continental United States, U.S. Army

Cases and Rates per 1000 strength per annum by months  
January 1942 to June 1945 inclusive

Year	Month	Cont. U.S.		E.T.O.		Year	Month	Cont. U.S.		E.T.O.	
		Cases	Rates	Cases	Rates			Cases	Rates	Cases	Rates
1942	January	1437	10.3			1944	January	8235	22.5	1077	17.5
	February	1305	10.0	2	6.5		February	7078	19.9	934	13.3
	March	1724	11.6	4	5.1		March	6911	16.2	1748	16.9
	April	1314	8.2	4	4.6		April	4482	13.5	1403	15.1
	May	1797	8.4	6	2.8		May	3414	10.6	1156	11.5
	June	1425	7.6	14	3.9		June	3125	7.9	851	6.7
	July	1607	6.5	40	6.3		July	1988	6.5	486	4.5
	August	1604	7.6	53	6.0		August	1724	5.7	476	3.8
	September	2708	11.9	67	5.3		September	2266	6.3	576	3.5
	October	4975	16.2	175	10.5		October	2235	8.1	818	5.9
	November	5059	18.5	337	30.2		November	2389	9.2	1191	7.8
	December	7153	24.4	131	14.0		December	3127	10.2	2143	9.5
Total		32108	12.7	833	11.5	Total		46974	11.7	12859	8.7
1943	January	11576	27.2	200	18.3	1945	January	2979	12.8	2556	13.0
	February	8786	23.6	182	21.5		February	3243	14.6	2988	14.5
	March	9418	24.7	84	10.1		March	3765	13.9	3618	13.7
	April	10114	20.4	120	11.4		April	2473	11.4	2623	12.0
	May	6733	16.6	52	5.5		May	2541	11.6	2047	9.2
	June	5252	12.9	76	6.3		June	3041	10.7	1354	5.1
	July	4846	9.6	115	6.0			18042	12.49	15186	11.1
	August	3556	8.8	117	6.0		Total	179195	13.65	32008	10.1
	September	3501	8.8	137	5.9		TOTAL				
	October	4826	9.8	417	11.4						
	November	4319	11.3	572	14.0						
	December	9144	19.5	1058	16.3						
Total		82071	16.0	3130	11.8						

Source: Division of Medical Statistics, Office  
of the Surgeon General, War Dept.,



Table 6

## PRIMARY ATYPICAL PNEUMONIA, ETIOLOGY UNKNOWN

United Kingdom and Continental Europe

Cases and rates per 1000 strength per annum, by months

July 1944 to June 1945 inclusive

Month	United Kingdom		Continental Europe		Total	
	Cases	Rates	Cases	Rates	Cases	Rates
July 1944	267	2.6	41	7.9	308	2.8
August	255	4.0	52	.8	307	2.4
September	293	4.4	91	.9	384	2.3
October	322	7.7	223	2.3	545	3.9
November	373	9.1	443	4.0	816	5.4
December	651	10.8	722	4.3	1373	6.1
January 1945	610	12.4	933	6.4	1543	7.9
February	543	11.5	1351	8.5	1894	9.2
March	481	9.5	2080	9.7	2561	9.7
April	361	9.3	1511	8.4	1872	8.6
May	249	8.3	1131	5.9	1380	6.2
June	158	3.4	816	3.8	974	3.7
Total	4563	7.1	9394	5.7	13957	6.1

Source: Division of Medical Statistics, Office of the Surgeon General,  
War Department, Washington, D. C.

Table 7

PRIMARY AND SECONDARY PNEUMONIAS, AND PRIMARY ATYPICAL PNEUMONIA

European Theater of Operations and Continental United States

U. S. Army

Deaths and Rates per 1000 strength per annum for period January

1942 to June 1945 inclusive

Type	European Theater of Operations		Continental United States	
	Deaths	Rate	Deaths	Rate
Primary and Secondary Pneumonia	93	.0292	660	.0503
Primary Atypical Pneumonia	41	.0129	100	.0076
Total	134	.0421	760	.0579

Source: Division of Medical Statistics. Office of the Surgeon  
General, War Department, Washington, D.C.

Table 8

PRIMARY PNEUMONIA

European Theater of Operations, U. S. Army

Deaths and rates per 1000 strength per annum by years

February 1942 to June 1945 inclusive

Year	Deaths	Rates
1942	0	0
1943	2	.0076
1944	30	.0204
1945	32	.0234
Total	64	.0201

Source: Division of Medical Statistics, Office  
of the Surgeon General, War Department,  
Washington, D. C.



Table 9

## SECONDARY PNEUMONIA

European Theater of Operations, U. S. Army

Cases and rates per 1000 strength per annum, by months

February 1942 to June 1945 inclusive

Month	Total		1942		1943*		1944		1945	
	Cases	Rates	Cases	Rates	Cases	Rates	Cases	Rates	Cases	Rates
January	59	.2			4	.4	25	.4	30	.2
February	53	.2	2	6.5	1	.1	9	.1	41	.2
March	63	.2	1	1.3	3	.4	28	.3	31	.1
April	58	.2	0	0	3	.2	13	.1	42	.2
May	33	.1	0	0	2	.2	10	.1	21	.1
June	28	.1	0	0	2	.2	17	.1	9	.03
July	30	.2	0	0	4	.2	26	.2		
August	17	.1	3	.3	3	.2	11	.1		
September	17	.1	2	.2	1	.04	14	.1		
October	16	.1	0	0	6	.2	10	.1		
November	47	.2	6	.5	18	.4	23	.2		
December	64	.2	6	.6	25	.4	33	.1		
Total	485	.2	20	.3	72	.3	219	.1	174	.1

Source: Division of Medical Statistics, Office of the Surgeon General, War Department,  
Washington, D. C.



## FIGURES

1. Primary Atypical Pneumonia, etiology unknown, European Theater of Operations and Continental United States, U. S. Army, admission rates per 1000 strength per annum, by months, February 1942 to June 1945, inclusive.
2. The Pneumonias, All Forms, European Theater of Operations and Continental United States, U. S. Army, admission rates per 1000 strength per annum, by months, January 1942 to June 1945, inclusive.
3. Primary and Secondary Pneumonias, and Primary Atypical Pneumonia, European Theater of Operations and Continental United States, U. S. Army, mortality rates per 1000 strength per annum for period January 1942 to June 1945, inclusive.





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1. Primary Atypical Pneumonia, etiology unknown, European Theater of Operations, U. S. Army, Cases and Rates per 1000 strength per annum, by months, February 1942 to June 1945, inclusive.
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A HISTORY OF PREVENTIVE MEDICINE  
IN THE  
EUROPEAN THEATER OF OPERATIONS  
UNITED STATES ARMY  
1941 - 1945

Part III - Epidemiology

Section 4 - Infections Transmitted by  
Discharges from the Respiratory  
Tract

by

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## PART III

### Epidemiology

#### Section 4 - Infections Transmitted by Discharges from the Respiratory Tract

Streptococcal Infections.--Scarlet fever and the other streptococcal infections have always been notably frequent in Europe, and it was therefore not surprising that these conditions were more frequently observed in the European Theater than in any other of the nine Theaters of Operation during the war just past. Nevertheless, the average annual rate for the four years was less than one-third the frequency of these conditions in the Zone of the Interior; and that holds for all principal diseases within the group, scarlet fever, rheumatic fever, and streptococcal sore throat.

Scarlet Fever.--A year with anything approaching an epidemic situation was never noted during the time that American Troops were stationed in Europe. The average annual rate for scarlet fever during the four years was 0.62 per 1000 strength per annum, and the fluctuations from year to year were never great. The best year was in 1943 and the year with highest incidence, 0.64 per thousand strength per annum, was in 1944. The year 1945 judged by the first six months gave indication of being an average year. (Table 1)

The experience on the continent was almost identical with that in Great Britain, during the single year that operations were conducted in both parts of Europe. (Table 2)

Scarlet fever in common with the other streptococcal diseases was more frequently observed in the European Theater than in other, with the North American group next in order. The disease was least common in the theaters of the far eastern group, in accordance with the known behavior of the disease. (Table 3)

While the total number of cases that occurred during the history of the theater was relatively large, 1987, no appreciable grouping was ever observed and no circumscribed epidemic came within the experience of the theater. No special program of control or epidemiologic study was instituted.

Rheumatic Fever.--The frequency of rheumatic fever followed closely the pattern of scarlet fever. The condition was most commonly observed in 1944, and the rates for 1945 were much the same. The best years of the theater were those of 1942 and 1943. (Table 4) The usual seasonal distribution in the months of late winter and early spring was characteristic. In contrast to scarlet fever, rheumatic fever was considerably more frequent in the United Kingdom than on the continent during the period when operations took place in both localities. (Table 5)

Among theaters of operation the leading position in respect to rheumatic fever was held by the European Theater with a total of 1,597 cases reported for the four years, and an average attack rate of 0.50 per 1000 strength per year. The rate of itself is good, and probably a reflection of the generally low levels of streptococcus infection. This figure is to be compared with the incidence for troops stationed in continental United States during the same period, where the rate was 1.07, essentially twice as great. The high rate noted in the African-Middle East Theater was somewhat surprising but the number of cases was small and too great significance is not to be attached to the observation. The China-Burma-India Theater ranked third. (Table 6)

Streptococcal Sore Throat.--Information on the frequency of streptococcal sore throat in the European Theater was available only for two years, 1944 and 1945, because the condition became reportable only with the change in the form of the Weekly Statistical Report in February, 1944. The rates cited in Table 7 are in accord with the behavior of other streptococcal diseases during the period noted.

Diphtheria.--Periodic waves of increased prevalence associated with enhanced clinical severity have characterized diphtheria in Europe for many years, more on the Continent than in Great Britain. A highly satisfactory immunizing agent exists for diphtheria, but its use was not obligatory for United States troops. War Department regulations prescribed the methods to be used for specific protection, but left the decision as to their use in Theaters of Operation with the responsible Surgeon. Because of these circumstances an early review was made of the existing situation in Great Britain, shortly after the European Theater was established, in order to determine whether or not universal or selective use of a specific diphtheria preventive was essential or desirable.



From the Ministry of Health in Great Britain it was learned that the diphtheria situation in the civilian population was of no particular import (Table 8); that it compared favorably with conditions in the Zone of the Interior; and that while a slightly increased frequency of the disease had become manifest during the early war years, the rate had never been alarming and the general trend of diphtheria since 1940 had been downward. Similar inquiries concerning the incidence of diphtheria among soldiers of the British Army stationed in England showed the rates to be decidedly low.

Decision was therefore taken that neither general nor selective immunization of troops would be practiced, but that a procedure would be prescribed in directives of the Theater to be used optionally by commanding officers of units that might be especially exposed to the disease, such as the staffs of General and Station Hospitals. Continued statistical records of the frequency and character of the disease were maintained, with special field surveys made from time to time in order that early information might be at hand to permit alteration of this policy should circumstances so demand. That eventuality did not materialize. The low attack rates for diphtheria among American troops stationed in the United Kingdom substantiated the soundness of the determined policy.

The situation that presented when plans came to be made for the invasion of the continent was measurably different. Diphtheria had regularly been more prevalent there than in the United Kingdom, and the case fatality was greater. A comprehensive survey of the more recent experience of countries in western Europe was prepared by the Division of Medical Intelligence. It clearly demonstrated that diphtheria had increased to a decided extent during the war years, and the existing incidence marked the disease as one of appreciable importance among infections likely to be encountered by American troops. (Table 9)

Current practice in immunization against diphtheria varied among British troops intended for the European Campaign. Protection was routinely required for the Canadian forces but not for troops of the United Kingdom. The desirability of immunization for American troops was again reviewed.

The general immunity status of American soldiers was assayed in order to arrive at a justifiable decision. A Schick test survey in the European Theater was not made, because the results of a recent study conducted among comparable groups of soldiers from the Ground Forces and Services of Supply in the

United States were available. Some 56 percent of troops had been found non-susceptible to diphtheria. Epidemiologic studies have demonstrated that immunity of fifty per cent of a population is effective in affording community protection against an outbreak of diphtheria.

The probabilities were estimated of the extent to which military personnel might be expected to contract diphtheria from civilian populations in the course of active operations. The critical part of the European campaign was anticipated in late spring and early summer of 1945, a time of the year ordinarily associated with a low incidence of diphtheria. The chance of contracting diphtheria from civilians in areas where the major forces of the army strength would be concentrated and under combat conditions was considered to be minimal.

In view of these circumstances, routine active immunization against diphtheria was judged unnecessary in planning for operations of the immediate future. Small outbreaks in reserve and rest areas were believed possible. In such instances the original policy of selective immunization for exposed units would apply.

The Standard Operating Procedure for the continental campaign provided that preliminary Schick testing of individuals in exposed units was not to be done, inasmuch as it was time consuming and impracticable in the course of active operations. In lieu of this, all men were to be given 0.1 cc of diphtheria toxoid (plain) subcutaneously. Experience indicated that about one-fourth of a general military population would react to this dose within 48 hours. These men were to be dropped, with the remainder to receive 0.5 cc of diphtheria toxoid subcutaneously two days after the initial dose. Again another one-fourth would be expected to have a reaction and these men would likewise receive no more toxoid. Three weeks later non-reactors received 1 cc subcutaneously, followed in another three weeks by a second similar and final dose of toxoid. Reactors to the third injection were not to receive the fourth.

This procedure would be expected to raise the general level of immunity within the group sufficiently to prevent a serious outbreak. A small dose of toxoid often constitutes an effective antigenic stimulus in individuals possessing some degree of latent immunity.



Incidence of Diphtheria in the European Theater --The admission rates for diphtheria during the first year of the theater were equivocal, not good and yet not of particular concern, the average being 0.47 per thousand strength per annum. The rate was great enough to keep active the question of instituting general immunization of troops. ✓

Because of the generally falling rate in the civilian population, it was decided not to institute the procedure during the summer of 1943, the most desirable time of the year for starting an immunization program against diphtheria. The frequency of the disease during the following winter of 1943-1944 justified that decision, for diphtheria was less commonly observed than ever before in the experience of the European Theater and indeed the rates were most favorable. The admission rate for 1944 was 0.17 per thousand per year.

The increased rates for November and December of 1944, 0.36 per thousand, were in accord with the greater expectancy anticipated on the continent compared with Great Britain. Of themselves, the rates were of no special concern, in fact they were no greater than had held for the first year in Great Britain. Any significance they possessed was as an index of what might prevail during the spring months.

It was reasonable to believe that the rates would be somewhat higher than, but certainly not to an extent which would warrant universal immunization, nor even a program restricted to troops of the Ground Forces who would expectedly be more affected than others, because diphtheria in Germany was excessive.

The autumn of 1944 saw the beginning of the final campaign against Germany. The existing tactical situation required any proposed immunization scheme to be supported by evidence of complete essentiality. The number of casualties and patients evacuated for illness and injury were of such extent that the demand on hospital beds severely taxed existing facilities. Previous experience with diphtheria immunization of adults indicated that a measurable number of admissions to hospital would follow that procedure. Military necessity required that the full number of effectives be maintained.

The indication of a future greater prevalence derived from the experience of November and December was substantiated in January 1945, when the rate for diphtheria was 0.57. It increased progressively to reach a high point during April of 1.05 per thousand and strength per year. Thereafter, the disease was less common and June had a rate of 0.67.



The rates cited are relatively great for the age group concerned but not strikingly so. It was also known that they are higher than actual fact. The data were derived from the Statistical Health Report. Actual field survey in the case of this and other diseases had shown that for conditions such as diphtheria, typhus, and typhoid fever, the rates from this source of information were measurably exaggerated. For typhus fever the reported attack rate was four times that determined by actual survey; and in the case of typhoid fever it was twice as great. This came through including with the records of American soldiers numerous infections among prisoners of war and displaced persons who were cared for in military hospitals of the United States Army. The 1,377 cases and an average annual case rate of 0.43, Table 10, will be measurably less when determined by the more accurate count of individual case records.

Diphtheria in 1944-45 was measurably more frequent on the continent than it was in the United Kingdom. The rates for the period September 1944 to June 1945 are set forth in Table 11. The rate for troops stationed in the United Kingdom was 0.23, compared with 0.69 for those serving on the continent. In only one month, May of 1945, did the rate in Great Britain exceed that on the continent.

Mortality from Diphtheria.--No deaths from diphtheria occurred in the years 1942 and 1943, and none in 1944 until operations started on the continent. The number of deaths during the latter half of 1944 was five; and indeed beginning in September 1944, no month thereafter was free from a death from diphtheria. There were nine in the month of April and eleven in June. Deaths for the first six months of 1945 numbered 28, and for the entire experience of the theater the total was 33, for an average mortality rate of 0.01 per thousand per year. The case fatality rate of 2.40 per hundred cases was favorable for this disease, even in view of the age group involved which generally shows a favorable result.

Chronic Cutaneous Diphtheria.--Chronic cutaneous diphtheria, long known to be a prevalent condition in North Africa and the Middle East among soldiers, was observed among troops returning to the European Theater from the Mediterranean Theater of war. The increased numbers of similar cases reported from Central Europe gave added interest to this form of the disease from a military standpoint.

Chronic cutaneous diphtheria is to be distinguished from the acute form which occurs in conjunction with faucial diphtheria particularly among debilitated individuals. The chronic form in most instances was unassociated either with diphtheria of the upper respiratory passages or with the carrier state. The condition commonly resulted from contamination of pre-existing skin lesions with virulent diphtheria bacilli. The disorders most commonly affected were minor or major wounds, either traumatic or surgical, insect bites, impetigo, staphylococcus-folliculitis, and scabies. Because of this pathogenesis chronic diphtheritic lesions were often multiple.

The lesions were usually on the exposed parts of the skin, the face, hands and forearms and over the legs and feet. Hairy surfaces were especially susceptible. The disease was most often encountered during outbreaks of faucial diphtheria when contact with active cases and carriers was frequent.

The development of diphtheritic infections of the skin was slow. It was usually two or three weeks after onset that the chronicity of the lesion, the progressive increase in size and failure to respond to ordinary treatment suggested to the medical officer something more than an abrasion or a minor infection. At this time the individual lesion was characteristically a punched-out circular ulcer whose base was covered with adherent blackish membrane and whose margins were raised, undermined and of an unhealthy appearance. Considerable regional edema was not unusual and the entire lesion tended to be painful. The systemic reaction was minimal and fever if present was low grade.

The diagnosis of cutaneous diphtheria could not be made from the appearance of the lesion alone, since tropical ulcer, cutaneous leishmaniasis and other chronic ulcerative dermatitides have a similar appearance. Cutaneous diphtheria is to be considered in differential diagnosis of these conditions and appropriate cultures made.

Early recognition was important because healing occurred only after specific treatment with antitoxin. The patient with cutaneous diphtheria as with faucial diphtheria was a menace to public health as a focus for spread of the infection. Finally, only by early and adequate treatment with antitoxin could the dangerous late complications of diphtheria be avoided.

Wound Diphtheria.--Diphtheritic infection of war wounds was encountered with relatively frequency among German prisoners of war but was a rare observation among troops of the United States forces. The commonest clinical manifestation of diphtheritic



infection of wounds was the presence of a tough, adherent, grey-yellow membrane over the wound, but all wounds covered with membranes were not diphtheritic. Similar membranes often failed to give cultures of the diphtheria bacillus, a common finding being C. xerosis, often in almost pure culture. The significance of this observation was uncertain as the organism is a nonpathogenic member of the corynebacterium group. Delayed healing was an indication for culturing a wound for the diphtheria bacillus. One patient had a clean granulating wound that did not heal. Two others had positive cultures from draining sinuses associated with osteomyelitis. Four patients with diphtheritic wound infection showed failure of skin grafts to take, either partially or completely.

Wounds other than those associated with battle casualties were also infected with diphtheria bacilli, one infection complicating circumcision and another engrafted on a non-specific penile ulcer.

The Clinical Disease in Germany.--An increase in diphtheria had taken place in Germany over the past two decades. From 1924 to 1927 a particularly severe clinical form had been noted. Again in 1937 or thereabouts, diphtheria began to be more frequent. The peak year in Munich was 1943, with a moderate decline of cases and deaths for 1944 and 1945, although from 500 to 700 cases of diphtheria were being admitted to hospitals of that city each year and the laryngeal form was common.

A higher incidence of diphtheria appeared to exist in Germany than in the United States. The disease was of a mild type except in those coming late to treatment.

The observed frequency of severe myocarditis among patients of the U. S. forces was less than expected. Peripheral nerve paralysis developing late in the clinical course was above expectancy. In a series of cases coming to autopsy only one had received antitoxin as early as the fifth day. No evidence existed of a correlation between the severity of infection and the type of diphtheria bacillus. The principal difficulty appeared to rest in late diagnosis and failure to observe the cardinal principle of administering diphtheria antitoxin on the basis of clinical observation rather than awaiting bacteriologic confirmation.

A special survey of diphtheria in late spring and early summer of 1945 was directed toward determining the conditions which had produced diphtheria and to formulating recommendations for the subsequent winter, when the Army of Occupation would in all probability encounter a problem in relation to diphtheria because of



more intimate contact with civilian populations. While little diphtheria existed in the military population at that time, the disease was prevalent in the civilian populations of Central and Northern Germany, in Berlin and Bremen particularly.

The relation of late complications and deaths to delayed administration of antitoxin was confirmed. The occurrence of at least half of cases among civilians in the adult age group suggested a likely increasing rate for military personnel. There was every reason to believe that the prevalence of the disease among troops in the Spring of 1945 would be exceeded the following winter under conditions confronting an occupation army.

Diphtheria Among Prisoners of War.--During the period of active operations more than twice as many cases of diphtheria occurred among German prisoners of war than among the much greater numbers of American troops. From September 1944 to June 1945, inclusive, diphtheria cases among United States troops numbered 1202; and for prisoners of war the figure was 2859. The rates were of course far greater, in the order of about ten times; for prisoners of war 6.2 per thousand per year, with a maximum incidence in March 1945 of 10.8 per annum. (Table 12) This disproportionate incidence among prisoners of war compared with soldiers of the United States Army was in about the same ratio as held for diarrhea and dysentery, and for typhus fever.

Only incomplete data are available for deaths. The advance Section of Communications Zone cared for 695,400 prisoners during the six-week period from 1 May to 15 June. During that time, 1080 cases of diphtheria occurred among the prisoners, of whom 40 died. The mortality rate per thousand per year was thus 0.499 and the case fatality 3.7 percent. Prisoners of war included numbers of relatively young persons, some aged no more than 14 to 16 years, and the greater case fatality was therefore not altogether unexpected.

The exaggerated frequency of diphtheria among prisoners of war during the spring of 1945 was indicated by such unusual circumstances as existed in a particular week in April, when more patients with diphtheria came from the relatively small group of prisoners of war in two single enclosures, than from the approximately three million American soldiers. The disease occurred in greatest numbers among prisoners who had been confined since the winter and early spring of 1944-45. Summer brought fewer cases but carrier rates remained high among groups where the disease had been prevalent. In some sampled groups ten percent of prisoners were carriers of virulent *C. diphtheriae*.

Diphtheria in the Several Theaters of Operation.--The European Theater ranked fourth among the nine theaters of the United States Army in respect to rates for diphtheria. The highest rate for any theater was that of 0.84 for the Mediterranean area. The best record was in the North American theater with a rate of 0.02. The rates for continental United States were particularly good, 0.06. (Table 13) For all theaters diphtheria occurred more frequently in 1945 than in other years of the war.

Vincent's Angina.--In contrast with the experience of the first World War, Vincent angina was a matter of far less concern during present military activities. The attack rate for troops for the total experience was two per thousand per year. The condition was most common in 1943 and the rates for 1945 were easily the most favorable. (Table 14)

Meningococcus Meningitis.--Meningococcus meningitis was present in epidemic proportions in Great Britain during 1940 and 1941. It was not surprising, therefore, that the disease appeared rather promptly among the first contingents of American troops that arrived in the British Isles. The disease among troops of the theater was more frequent that year than in any other of the war period and the annual incidence of 1.32 per thousand strength per year was relatively great. (Table 15) The experience of the United States Army coincided with that of the British civilian population, and of British troops stationed in the United Kingdom at that time. To an extent the situation carried over through 1943 but the rates never reached the same height that had characterized 1942 during any month, and the annual rate was somewhat lower.

Meningitis was far less frequent in the general population of Great Britain in 1944, and likewise among American troops. Much the same situation held when the main forces of the United States Army moved into Europe, for again the rates in 1945 for meningococcus meningitis among United States troops were satisfactory. The disease showed no variations in prevalence in Great Britain that year as compared with the continent and for both localities was favorable. (Table 16)

Epidemic meningitis was little more than half as frequent among American troops in Europe in this war as it was in World War I, the average rates for the two periods being 1.11 in 1918 and 0.67 for the present experience. This favorable behavior of a disease which so characteristically invades military populations was in agreement with the relatively low prevalence of meningococcus meningitis in continental United States, where the severe outbreaks of the first World War were never noted.



The epidemiologic pattern of the disease in Europe in World War II was much the same as has been described in the previous war, in that the condition tended to occur sporadically. No extensive epidemics appeared and such groupings of cases as were noted were of minor nature. That a goodly proportion of the infections among American troops were imported from the Zone of the Interior became manifest by the frequency with which the disease was recognized on board transports, and the decidedly greater frequency among newly arrived troops, compared with those resident in the theater for appreciable periods.

Mortality from Meningococcus Infection.--Two deaths among troops of the theater were ascribed to meningococcus septicemia and 99 to meningococcus meningitis, a total of 101 from meningococcus infections. The mortality rate per thousand strength for the period of operations was 0.03 and the case fatality 4.6%.

The remarkable improvement in mortality and case fatality in civilian practice which became evident with the advent of the sulfonamides was clearly duplicated in this military experience. Those whose experience extended to the days of serum treatment and especially to the serious outbreaks of the previous war still found difficulty in appreciating that a case fatality of 4.6 percent could exist for a general military experience involving so many different field conditions, and the results of treatment by so many different medical officers. The case fatality during World War I was 43.3 for American troops stationed in Europe and the annual mortality was 0.48.

Meningococcus Meningitis in the Various Theaters of Operations.--Meningococcus meningitis was a more common disease in the European Theater than in any other of the nine theaters of operation. The number of cases was 2138 and the attack rate was 0.67 per thousand per year. This was almost double that of the next reporting theater, the Mediterranean area, whose rate was 0.36 per thousand strength per annum.

In comparison with troops stationed in the Zone of the Interior the experience of the European Theater was very favorable, since the rate for domestic troops during the war period was 0.80. Epidemic meningitis for all foreign Theaters of Operation had an average incidence of 0.41 which was appreciably less than that holding for the European Theater. (Table 17)



Program of Control.---The usual isolation measures were rigidly practiced. The routine search for carriers of meningococci, so commonly practiced in former years, was almost completely discarded. Bacteriologic examinations were usually made of immediate contacts and sometimes for small groups of closely associated persons under special epidemiologic situations, but no mass survey was ever attempted. Principal reliance was placed on prompt separation of individuals suspected of having the disease, on frequent clinical inspections and examinations of exposed persons, and on institution of the general measures designed to control infections spread by secretions of the upper respiratory tract. Working quarantine was discouraged. Because this method had been employed for many years, it was instituted in many instances without reason or measurable accomplishment.

Chemoprophylaxis found its best indication in the control of meningococcus infections. Proof was definitely brought forth that meningococcal infections could be controlled by the prophylactic administration of sulfonamides, particularly sulfadiazine. Following the administration of sulfadiazine the incidence of carriers dropped to low levels and remained low for a prolonged period. Simultaneously with this reduction in carrier incidence, a striking reduction in the number of cases of meningitis could be expected.

The conditions under which healthy personnel should receive sulfadiazine during an epidemic could not be exactly defined. The decision was based on the judgment of the Surgeon but certain general rules for guidance were suggested. A single case of meningitis was considered rarely to justify general prophylactic treatment of the unit. An exception might be a single case in a unit living under crowded conditions which were apt to persist for a number of days, as on a troop transport. In general an incidence of more than 0.2 per thousand per week among large concentrations of troops and the occurrence of more than two cases in a week at a camp or station with a strength of ten thousand or less warranted consideration of this measure. Particular consideration was given to an existing concentration of cases in a particular unit. Instead of treating an entire command it was many times better to treat a particular unit, such as a regiment or a battalion in which the incidence was especially high.

Two grams of sulfadiazine was administered by mouth in one day in a single or divided dose. This dosage was effective in reducing the carrier rate and caused practically no toxic reactions.

Tuberculosis.--Tuberculosis control in the European Theater was combined with the clinical management of patients under the direction of the Senior Consultant in Tuberculosis, Lt. Col. Theodore Badger, M.C., a member of the Staff of the Chief Consultant in Medicine of the Division of Professional Services. This concentration of effort and activities was most logical, in that the senior consultant in tuberculosis was not only skilled in the management of the clinical disease but experienced in field methods and control measures.

The Division of Preventive Medicine acted in a consultative capacity, with interest in integrating the work in tuberculosis into the general preventive medicine program of the theater. Its facilities and staff were at the disposal of the Consultant and the relationship maintained was in the best traditions of the coordinated effort which marked the practice of medicine and preventive medicine in the Theater.

Field survey work in tuberculosis was practiced most extensively in the Air Forces. Many hospitals of the Communications Zone gave particular concern to the members of their organizations, and numerous surveys of Ground Force and Communications Zone units were conducted by the consultant in tuberculosis. All of these sources are drawn upon in the preparation of this summary of events in tuberculosis control, with the technical details of particular studies and the results obtained left for more formal presentation by those principally concerned.

#### Incidence of Tuberculosis among United States Troops.

The tuberculosis rates for troops of the European Theater were maintained at a satisfactorily low level during the three and a half years during which operations were conducted in the United Kingdom and on the continent of Europe. The rates were highest during the first two years of the theater, with the high point of 1.31 per thousand strength per annum in 1943. The mean annual rate thereafter showed a satisfactory downward trend. That for 1945 was somewhat higher than 1944, but not appreciably so. The special epidemiological factors existing in the first half of 1945 might reasonably have been expected to produce a higher rate of incidence than that recorded. The overall rate for tuberculosis during the entire period of activities of the theater was 0.77 per thousand strength per annum. The data for the several years are presented by months in Table 18.



Several factors would appear to have influenced the downward trend of the tuberculosis rate among troops of the European Theater. First of all was the thorough sifting out of active cases of tuberculosis at induction points by mass chest x-ray survey, thereby reducing sources of infection and contacts. The relatively high rate of 1943 may be accounted for on the basis of early lack of experience at induction stations and the fact that universal pre-induction chest x-ray examination did not become effective until April 1942. A sampling by the Office of The Surgeon General in 1943 of some 50,000 x-rays of the chest made of men inducted in 1942 to determine how much tuberculosis had been overlooked, indicated that ten to fifteen cases per 10,000 men had visible lesions that had failed of detection at the time of induction.

The low rates of 1944 and 1945 bear witness to the thoroughness of the preinduction chest x-ray examination that emerged from greater experience in the interpretation of films. Sources of infection were thus reduced to a minimum within troops of the theater. Sources of infection from outside the Army were also decreased by the command prohibition of the consumption of whole fresh milk in the theater, a matter of no small importance since contamination of milk with tubercle bacilli was known to be serious. Furthermore, both the soldier and the medical officers of the theater were conscious of tuberculosis, and roentgen examination of the chest was widely used for troops of all echelons when tuberculous infection was suggested. These factors contributed to the falling rate.

Data for the period from September 1944 to June 1945 are available for the period of operations on the continent. The frequency of tuberculosis among troops stationed in the United Kingdom was significantly greater than that for troops serving on the continent, with rates of 1.03 compared with 0.60 for the two parts of the theater. To an extent this was a reflection of the active case finding in tuberculosis in the United Kingdom during most of this period, primarily among forces of the 8th Air Force.

The relatively great accretions in rates for April and May of 1945 and particularly the two peaks in the curve of incidence noted for the weeks ending April 20 and May 11, coincide with the return of American Prisoners of War who had appreciably great involvement with tuberculosis. (Figure 1) Special attention is given this group in a later section.

The distribution of tuberculosis for all troops of the European Theater by weeks during the period of active operations on the continent is presented in Table 19.



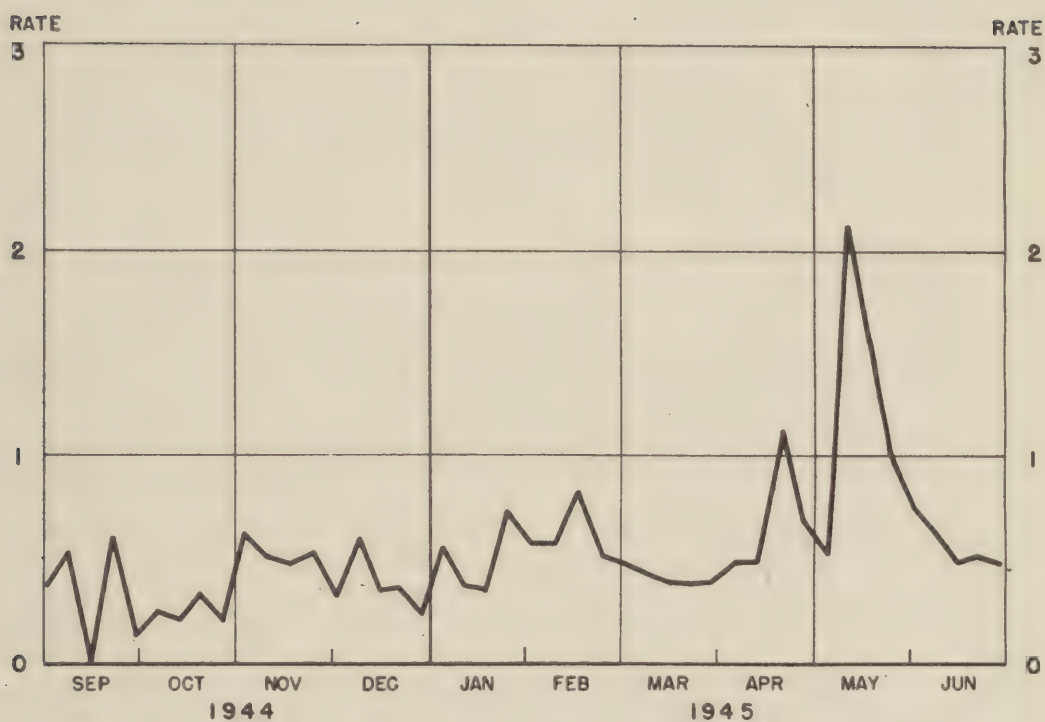


Figure 1.

Tuberculosis, all forms, in troops in Continental Europe, European Theater of Operations, U.S. Army, rates per 1,000 strength per annum, by weeks, September 1944 to June 1945, inclusive.



Field Surveys.--The first field survey of troops of the European Theater for tuberculosis was in 1943. The primary objective was to determine the frequency of the disease among military units who had been stationed for a year or more in the theater.

Survey of 1943.--The selection of units included all branches of the service, and the numbers subjected to roentgen examinations varied from 200 to 1,000 men of a unit. Units included some who had been in the European Theater for a year or more, others who had spent a year and two years in Iceland. Some units had never been examined by roentgen ray before or after enlistment. The units included ground forces, engineers, the members of station and general hospitals, colored troops, and fighter and bomber groups of the Air Force. Three separate surveys were accomplished during the year, the first in February, another in July, and a third in October. The results are presented in Table 20.

No significant amount of unrecognized tuberculosis was apparent among American troops of the theater. The majority of men studied had not been examined previously by roentgen ray during service in the army and very few had been on foreign service for less than one year. The results led to comprehensive recommendations for the disposition of patients with pulmonary and other forms of tuberculosis received at United States hospitals in the European Theater. A second recommendation provided for routine roentgen examination of the associated platoon, mess mates and bunk mates of soldiers found with open tuberculosis, to be repeated in six months. No need was believed to exist for a mass x-ray survey of troops of the European Theater.

Survey of British Civilians employed by the United States Army.--When the headquarters of the European Theater of Operations moved to the continent in the summer of 1944 British civilians, principally clerks and office workers, were given physical and roentgen examinations as a basis for acceptance for overseas duty. The results are shown on Table 21.

The incidence of reinfection type tuberculosis among British civilian employees was nearly four times as great as that demonstrated by similar roentgen studies of United States troops, 5.10 cases per hundred, compared with 1.39 for United States troops. Employees with demonstrable tuberculosis lesions, whether active or inactive, were not accepted for overseas duty.

Survey of 78th Fighter Group.--Roentgen survey of approximately 1200 men of the 78th Fighter Group, 8th Air Force, was made in the autumn of 1944. The survey arose from the original finding



of a case of active tuberculosis in the 83rd Fighter Squadron, 78th Fighter Group, 8th Air Force. Approximately 250 men of the 83rd Fighter Squadron had been examined and seven cases of active tuberculosis were found. The indications were that no single focus of contacts was responsible since the patients did not come from any one barrack or duty department. Because of the demonstrated high incidence a more extensive survey was undertaken.

In the course of the general survey, 20 men with positive roentgen findings were interviewed and examined individually. Twelve were admitted to hospital, including one with active pulmonary lesions with cavitation, two with pleural effusion of which one was probably non-tuberculous and nine patients with apical infiltrations of questionable activity. Five cases of pulmonary tuberculosis were found, of whom four gave a definite family history of tuberculosis but none showed evidence of activity.

The 20 men interviewed came from eight different barrack buildings. In only one instance were any two from the same sleeping room and they slept at the far corners of the building. Two of the men with apical infiltration had worked together. One stated that a man from his office had been evacuated from the 83rd Fighter Squadron with tuberculosis. No significant contacts were determined with British civilians. The active cases were believed due to reactivation of old lesions, with additional effect from contacts among the men themselves.

Tuberculosis Among Nurses.--A definite increase in tuberculosis occurred among nurses in the later years of the theater. No nurse was known to have developed tuberculosis in 1942. Four were observed the following year, and for 1944, 30 patients were recognized. For the first five months of 1945 the number was 38.

The high rates for tuberculosis and especially that of 5.24 per thousand per annum for the first five months of 1945 were not satisfactorily explained by simple presumption of a greater susceptibility of young women to tuberculosis. The lower threshold of resistance was conceivably influenced adversely by the conditions of war, fatigue, climatic changes, frequency of acute respiratory infections, changes in diet with relative deficiencies and the chronic mild anemias that were commonly found, but these factors are difficult to measure and evaluate. Carelessness in isolation technique in the nursing of tuberculosis patients was too widespread. Medical officers responsible for the care of tuberculous patients did not always impart the rules for prevention of spread of infection and for the protection of personnel. Nurses individually grew careless. No one cause can justly be credited with the progressively increased rates. (Figure 2 Table 22).

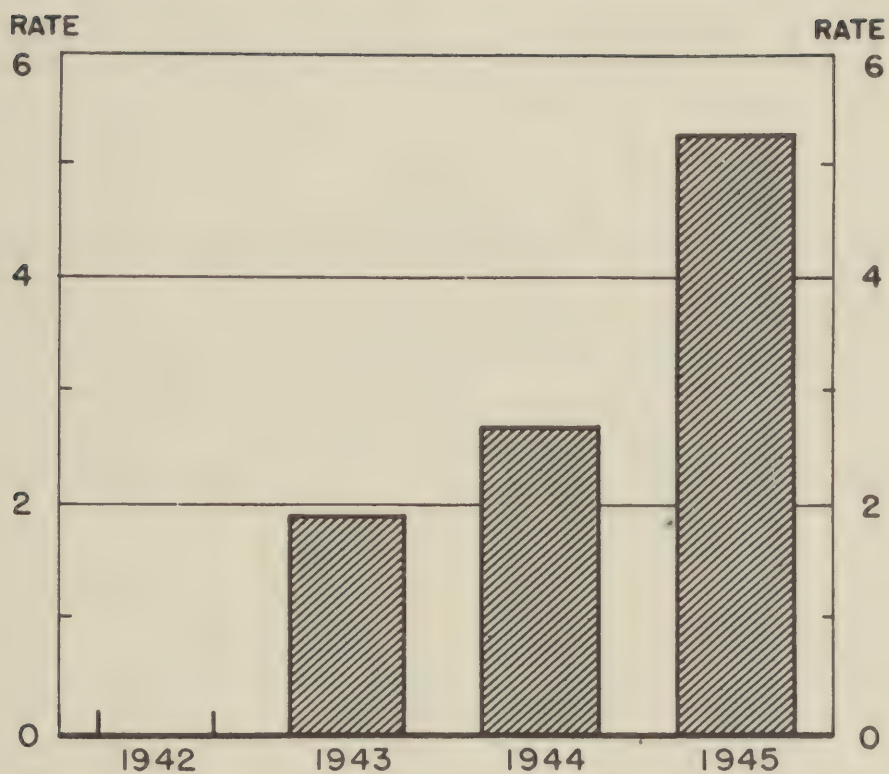


Figure 2

Tuberculosis, all forms, in Nurses, European Theater of Operations, U. S. Army. Rates per 1000 strength per annum February 1942 to May 1945, inclusive.





Survey of Officer Candidate School.--Chest x-ray examinations were made of candidates at the Ground Force Officers Training Center from March to May 1945. (Table 23) Since the men came from units all over the European Theater, the results present a cross section of the incidence of tuberculosis in the theater area, except that the general physical examination before entrance to the school and in some instances preceding roentgen examinations, may well have eliminated unlikely candidates.

General Survey of the Eighth Air Force.--A general survey of Eighth Air Force troops in the United Kingdom was taken in April of 1945. The original plan was to survey the personnel longest in the United Kingdom, but the redeployment program frequently interfered.

During a three-month period mobile units examined approximately 30,000 men. Follow-up investigation sufficient to establish a positive diagnosis was completed by 16 July 1945 for approximately 80 percent of the questionable cases. Records of 23,250 apparently healthy military personnel showed 33 or 0.14% to have active pulmonary tuberculosis requiring hospitalization. Persons with probable activity numbered 19; and 1,037 gave evidence of inactive pulmonary tuberculosis requiring follow-up study, or 4.4 percent of those surveyed. Certain individuals with abnormal x-ray findings had already returned to the Zone of the Interior by the time units were notified of the results of the examinations. The necessary follow-up was accomplished in the Zone of the Interior, but the results were lost to the survey.

American RAMP (Recovered Allied Military Personnel).--American soldiers recovered from German prisons as United States troops entered Germany, were returned through the normal evacuation system for casualties. They were admitted to hospitals when primary or complicated malnutrition was serious. As patients they were examined roentgenologically for evidence of tuberculosis with the results shown in Table 24.

The sample was not representative of RAMP in general, since the men examined were all patients in hospital. The incidence of tuberculosis was approximately eight times that of United States troops in 1943, and 20 times that of the officer candidates of 1945; although the members of the last two groups were normal, healthy United States troops on full duty and the comparison is scarcely just.

The influence of starvation on tuberculosis during the period of imprisonment of RAMP could not be immediately evaluated. Many unknown factors could conceivably play a significant role in the apparently high incidence. It is reasonable to believe that factors peculiar to the situation were reflected in the higher rates. Surveys of United States troops in all theaters showed the incidence of tuberculosis to have been at a rate of about 1.0 cases per thousand per annum ever since the war started. In the European Theater three briefly maintained peaks of incidence of a few weeks duration, but never exceeding a yearly rate of 4 per thousand, constituted an exception to anticipated behavior of the disease. Four factors are important in evaluating the causes of these incidents associated with the liberation of American RAMP.

The first was the liability to infection. American troops were well screened by individual roetgen examination before induction, and the low rates for active tuberculosis minimized contact spread of tuberculosis within the Army. The RAMP before capture by the Germans were presumably like all other soldiers of the United States Army. Segregation of United States prisoners from those of allied armies was usual, and contacts from other active sources of tuberculosis were apparently not important. In the migration of prisoners from camp to camp across Germany, gross contamination of living quarters by previous occupants ill with tuberculosis was known to have occurred. These contacts may have been a source of infection.

The individual constitutional factor and familial background of these soldiers was not known. The influence of environmental factors was apparent in the extreme degree of malnutrition which commonly existed and in the extremely favorable opportunities for contract wherever an open case of tuberculosis was present. Finally, the reported 101 cases of tuberculosis for the week ending 11 May 1945 are believed to include an unknown number of Allied rather than American RAMP.

None of these four factors can be identified as the single cause responsible for the high tuberculosis rate among American RAMP. It is reasonable to believe that if the men had continued as prisoners for a matter of years, the tuberculosis rate would have increased inevitably, first through the opportunity for contact, and secondly because of the long continued effects of malnutrition.

Tuberculosis Among Displaced Persons and Allied RAMP.--  
As was the experience with acute communicable diseases, the real tuberculosis problem of the theater was among Displaced Persons. On December 18, 1944, 304 tuberculous patients of varying



nationalities but mostly Russian, were admitted to an American General Hospital. Four were dead on arrival; 90 percent had moderate to advanced disease; 28 died of tuberculosis within the first week in hospital and up to 21 May, five months after admission, a total of 73 or one-third had died. Signs and symptoms of serious nutritional and vitamin deficiencies were the principal associated complications, to such an extent that symptoms related to tuberculosis were separated with difficulty from those due to malnutrition. Some 1600 military and civilian nationals were sent to another German Hospital in Besancon near Dijon about the middle of March, 1945. Seventy-five percent were Russian, but Yugoslavs, French, Italians, Poles, Turks, Belgians, Dutch, Czechs, Greeks, Hungarians, and Serbs were included. Almost half had tuberculosis, principally advanced disease complicated by severe malnutrition. Other displaced persons, largely under the care of the hospitals of the 3rd Army in Germany, included many with tuberculosis among the thousands liberated at Mauthausen, Nurnburg, Cham and other camps. A sample of 2,439 inmates studied by roentgen examination showed 972 to have active tuberculosis, a rate of 400 per thousand.

The principal factor which produced this fulminating disease was the opportunity for intense and frequent recurrent contact with patients seriously ill with open tuberculosis. The starvation diet produced a serious malnutrition, and doubtless contributed to the rapid progress of the disease.

Tuberculosis in Various Theaters of Operations.---The European Theater fared very well in comparison with other theaters of operations in respect to rates for tuberculosis. The mean annual rate of 0.77 ranked eighth among theaters and compared very favorably with the rate for continental United States, which was 1.19.

Of the nine theaters of operation, the highest rates for tuberculosis occurred in the China-Burma-India theater, followed closely by the Africa-Middle East Theater. The best rate was attained in the Mediterranean area. (Table 25)

Measles.---Admissions for measles among troops serving in the European Theater was at the favorable rate of 1.00 per thousand and strength per annum. For troops of the American Expeditionary Force serving in France in 1918 the rate was 5.50.

The number of primary admissions for measles for the whole period of operations was 3188. The occurrence by months and by years is shown in Table 26, where the usual seasonal predominance in the months of March and April is consistently demonstrated.



The distribution throughout the various years was characterized by its regularity; the greatest rate was in 1943 which coincides with the year of greatest prevalence in the Zone of the Interior. The rate then was only 1.17, compared with 0.86 for 1945, which was the most favorable year.

All of the common communicable diseases including measles, German measles, chickenpox, and whooping cough had much the same history of being especially prevalent among newly arrived troops, and in those units concentrated in staging areas after recent arrival. Such difficulty as the United States Army experienced with measles would appear largely related to imported infection, with contact commonly occurring on board transports. Infection acquired from civilian populations of Great Britain and France was a lesser consideration.

Little or no difference existed between the rates for measles on the continent and in the United Kingdom during the year of operations in the two localities. The rate for the continent was 0.65 and for the United Kingdom 0.53, Table 27.

The usual relative position of the European Theater among other theaters of the United States Army in respect to the frequency of communicable diseases was maintained for measles. The rate of 1.00 gave the theater fourth position.

Mumps and measles were most prevalent in the parts of the world where numbers of troops were small and where conditions ordinarily would not suggest an undue frequency of the disease, namely in the Latin American Theater and in Alaska. The best record among theaters was that attained by the Pacific Ocean Area and the African-Middle East Theater. (Table 28)

No deaths from measles were recorded in summaries of medical experience for the European Theater during the four years over which operations extended.

German Measles. --The attack rate for rubella was almost identical with that of measles. The number of cases was 2904 and the average rate for the period of operations was 0.91. The disease was most common in the first year of the theater when the rate was 1.50, but the annual variations were never great. (Table 29)

The rate for German measles on the continent and in the United Kingdom during the time the troops were stationed in both areas in 1944 and 1945 were statistically the same in a year of generally low incidence. (Table 30)

No theater had a problem of any moment with German measles. As with measles the rates were relatively high in the Alaskan, the North American and the Latin American Theaters; and in general, theaters of the American area had more German measles than the areas embraced in the general European region. (Table 31)

One death from German measles is recorded in summaries of medical experience in the theater. The attendant circumstances are unknown and the authenticity of the cause of death was not determined. It was an unusual circumstance to have a recorded death from German measles but none for measles.

Mumps.--The importance of mumps in military practice often remains unappreciated. In World War I epidemic parotitis was the most frequently observed communicable disease, other than influenza.

The period of disability is relatively long and once introduced into a command the infection tends to spread intermittently until the greater part of susceptibles are exhausted. Mumps is primarily a disease of recruits and as such was much less a problem in a theater of operations. Nevertheless the number of reported cases during the period American troops were in Europe was 10,263.

The history of mumps in the European Theater was characterized by the frequency with which note was made of the arrival of troop transports with patients with mumps aboard. Repeatedly such instances served to introduce the disease into units to which recruits came as replacements.

EPIDEMIOLOGIC CASE REPORT NO 1 - The 548th Quartermaster Battalion arrived from the Zone of the Interior 17 March 1944. Mumps occurred aboard the transport on which they travelled and in the headquarters detachment of the battalion four days after the unit landed in England. Another case in the 953rd Quartermaster Service Company of the same organization developed some days later. After the usual incubation period of two to three weeks more cases appeared in these two units and the disease spread to two other companies, the 961st and the 966th Quartermaster Service Companies. The outbreak eventually lead to a noneffective rate of approximately ten percent of the battalion as a whole and extended over about two months time.

Incidence.--The most characteristic feature of mumps in this military population was the regularity with which the disease occurred during the four years. The average rate for the



theater was 3.23 per thousand strength per annum, and no great variation was observed from year to year . ( Table 32) It is rather simple to pick out the time when measurable accretions to troop strength took place by the mounting incidence of mumps.

The rate for the first months in 1942 were greater than at any subsequent period. Conditions were relatively stable in 1943 because such major additions to troop strength as occurred came from the return of seasoned troops from Africa. Mumps was a minor problem. Great numbers of new troops fresh from the Zone of the Interior arrived in 1944 and also during the months of greatest seasonable prevalence of this communicable disease. The rates were again enhanced in a degree comparable with 1942. Mumps in 1945 was no problem as a veteran army plunged through Germany.

The seasonable distribution of mumps requires no comment. It followed established behavior patterns in being most commonly observed in the spring.

Although the period of operations on the continent was characterized by a generally low incidence of mumps, the difference between the prevailing rates in the United Kingdom and those of the continent marked the difference between freshly arrived troops and veteran combat organizations. (Table 33) The rates in the United Kingdom were 3.29 and for troops serving on the continent 1.54.

Mumps in Other Theaters.--While more cases occurred in the European Theater than in any other, the troop strength was much greater. A comparison based on rates shows the theater to have been third. (Table 34) The Alaskan Theater strangely enough had the greatest rate for the war period and the best record was obtained by the Mediterranean Theater where the relative standing for most other communicable diseases was usually close to the top. The rates for all overseas theaters was 2.27, compared with domestic rates in continental United States of 6.33, which was about three times as great.

Control Measures.--No outspoken epidemic occurred. The control measures were those directed against diseases spread by secretions of the upper respiratory tract. The principal difficulty encountered was the tendency of many commanders to impose working quarantine as a control measure, a procedure which has been repeatedly demonstrated of little value and yet affects adversely both training activities and the morale of troops. Such epidemiologic studies as were undertaken were in connection with freshly arrived troops and in search of causes of the prolongation of minor outbreaks.



Two deaths from mumps were recorded in the theater during the four-year period.

(Smallpox.)--Smallpox did not occur among American soldiers stationed in the European Theater of Operations. The one case of smallpox charged against the European Theater of Operations in the statistical data derived from the Medical Statistics Division of the Office of The Surgeon General is known to be in error, as the result of a field investigation made in the theater.

Smallpox occurred from time to time among civilians in the United Kingdom, and in several instances American soldiers travelled on transports bearing British troops infected with smallpox.

The first contact of American troops with smallpox in the United Kingdom was in July 1942 when a ship arrived at Glasgow carrying some 12,000 service and civilian personnel, including patients determined to have variola major. Subsequently, the disease spread to a moderate extent among the people of that city, a matter of concern to American authorities because of the heavy traffic from the Zone of the Interior. Control measures instituted by Scottish health authorities were rapidly effective.

Not long thereafter a ship arrived in Liverpool with 4,000 United States troops aboard, and a member of the Royal Air Force who had developed smallpox enroute. Such instances were not of particular concern because United States troops had been revaccinated immediately before departure for overseas duty. Observation during the period of incubation was directed, and a survey of the vaccination status introduced as a preventive measure. Occasional instances of similar nature were noted over subsequent years, but regularly without untoward incident. In early 1944 smallpox became mildly epidemic in Gibraltar, a center of shipping and travel to the United Kingdom. This circumstance led to intensification of scrutiny and inspection by both British and American authorities.

Smallpox was even less of a concern in the course of continental operations than it had been in Britain. The French population was in general well vaccinated, and the few infections that occurred among civilians were isolated and sporadic.

The number of cases of smallpox recorded for the entire United States Army during the period of the war was 89. Ten of them occurred in continental United States. The greatest number was observed in the China-Burma-India Theater, where 36 soldiers contracted this communicable disease. The Africa-Middle East Theater was next with 23, and 13 cases were noted in the experience of the Mediterranean Theater. In all other areas the numbers were small and three theaters had no smallpox. (Table 35)



Table 1

Scarlet Fever

European Theater of Operations, U.S. Army

Cases and Rates per 1000 strength per annum

February 1942 to June 1945, Inclusive.

Month	Total		1942		1943		1944		1945	
	Cases	Rate	Cases	Rate	Cases	Rate	Cases	Rate	Cases	Rate
January	154	.57			1	.09	85	1.38	58	.35
February	230	.81		--	5	.59	65	.92	160	.78
March	454	1.20	3	3.80	5	.60	194	1.88	252	.95
April	337	1.04	2	2.28	2	.19	151	1.62	182	.83
May	313	.94	3	1.41	3	.32	155	1.54	152	.69
June	182	.45	4	1.13	4	.33	83	.65	91	.35
July	54	.40	2	.31	8	.42	44	.40		
August	26	.17	4	.46	6	.31	16	.13		
September	33	.17	3	.24	6	.26	24	.15		
October	44	.23	5	.30	12	.33	27	.19		
November	66	.32	4	.36	22	.54	40	.26		
December	94	.31	5	.54	38	.58	51	.23		
Total	1987	.62	35	.48	112	.42	935	.64	905	.66

Source: Division of Medical Statistics, Office of The Surgeon General,  
War Department, Washington, D.C.





Table 2

Scarlet Fever

United Kingdom and Continent

European Theater of Operations, U.S. Army  
Cases and Rates per 1000 strength per annum  
September 1944 to June 1945, Inclusive

Month	Total		United Kingdom		Continent	
	Cases	Rate	Cases	Rate	Cases	Rate
1944						
September	24	.15	18	.27	6	.06
October	27	.19	21	.50	6	.06
November	40	.26	22	.54	18	.16
December	51	.23	31	.52	20	.12
1945						
January	68	.35	23	.47	45	.31
February	160	.78	27	.57	133	.84
March	252	.95	46	.91	206	.92
April	182	.83	34	.88	148	.82
May	152	.69	16	.54	136	.71
June	91	.35	9	.20	82	.38
Total	1047	.51	247	.52	800	.51

Source: Division of Medical Statistics, Office of  
The Surgeon General, War Department,  
Washington, D.C.





Table 3

## Scarlet Fever

Total Army, Continental United States and

Theater of Operations, U.S. Army

Cases and Rates per 1000 strength per annum

January 1942 to June 1945, Inclusive

Theater	Total		1942		1943		1944		1945	
	Cases	Rate	Cases	Rate	Cases	Rate	Cases	Rate	Cases	Rate
Total Army	29564	1.40	3110	1.02	13327	1.98	9381	1.25	3746	.97
United States	26824	2.04	2892	1.14	12991	2.53	8256	2.06	2685	1.86
Total Overseas	2740	.34	218	.42	336	.21	1125	.32	1061	.44
Europe	1987	.62	35	.48	112	.42	935	.64	905	.66
Alaska	87	.32	44	.88	28	.24	7	.08	8	.34
North America	52	.31	10	.25	28	.39	7	.17	7	.45
Africa-Middle-										
East	39	.30	1	.17	19	.36	14	.30	5	.21
Mediterranean	250	.18	0	--	52	.12	101	.15	97	.40
Southwest										
Pacific	183	.15	102	1.52	47	.24	19	.03	15	.04
China-Burma-										
India	45	.14	11	1.95	16	.35	12	.08	6	.05
Pacific										
Ocean Area	91	.09	14	.10	32	.11	27	.07	18	.09
Latin America	6	.02	1	.01	2	.02	3	.03	0	.00

Source: Division of Medical Statistics, Office of The Surgeon General, War Department, Washington, D.C.



Table 4

Rheumatic Fever

European Theater of Operations, U.S. Army  
Cases and Rates per 1000 strength per annum  
February 1942 to June 1945, Inclusive

Month	Total		1942		1943		1944		1945	
	Cases	Rate	Cases	Rate	Cases	Rate	Cases	Rate	Cases	Rate
January	99	.37			0	--	15	.24	84	.54
February	157	.55	0	--	4	.47	48	.68	105	.51
March	244	.65	0	--	2	.24	120	1.16	122	.46
April	252	.78	0	--	2	.19	144	1.55	106	.49
May	208	.62	0	--	4	.42	102	1.01	102	.46
June	198	.49	0	--	6	.49	92	.72	100	.38
July	105	.78	2	.31	10	.52	93	.85		
August	48	.31	2	.23	2	.10	44	.35		
September	61	.31	4	.32	0	--	57	.35		
October	51	.26	6	.36	5	.14	40	.29		
November	70	.34	10	.90	2	.05	58	.38		
December	104	.35	1	.11	20	.31	83	.37		
Total	1597	.50	25	.34	57	.22	896	.61	619	.45

Source: Division of Medical Statistics, Office of The Surgeon General, War Department, Washington, D. C.





Table 5

Rheumatic Fever  
United Kingdom and Continent  
European Theater of Operations, U. S. Army  
Cases and Rates per 1000 strength per annum  
September 1944 to June 1945, Inclusive

Month	Total		United Kingdom		Continent	
	Cases	Rate	Cases	Rate	Cases	Rate
1944						
September	57	.35	50	.76	7	.07
October	40	.29	19	.46	21	.22
November	58	.38	40	.98	18	.16
December	83	.37	39	.65	44	.26
1945						
January	84	.54	32	.65	52	.35
February	105	.51	34	.72	71	.45
March	122	.46	36	.71	86	.40
April	106	.49	39	.75	67	.37
May	102	.46	23	.77	79	.41
June	100	.38	16	.35	84	.39
Total	857	.42	328	.70	529	.33

Source: Division of Medical Statistics, Office of  
The Surgeon General, War Department, Washington, D.C.





Table 6

## Rheumatic Fever

Total Army Continental United States and

Theaters of Operations, U.S. Army

Cases and Rates per 1000 strength per annum

January 1942 to June 1945, Inclusive

Theater	Total		1942		1943		1944		1945	
	Cases	Rate	Cases	Rate	Cases	Rate	Cases	Rate	Cases	Rate
Total Army	16552	.78	820	.27	6330	.94	7055	.94	2347	.61
United States	14011	1.07	745	.29	6146	1.20	5681	1.42	1439	1.00
Total Overseas	2541	.32	75	.15	184	.12	1347	.39	908	.37
Europe	1597	.50	25	.34	57	.22	896	.61	619	.45
Africa-Middle-East	48	.37	1	.17	2	.04	30	.63	15	.63
China-Burma-India	103	.31	0	0	0	0	31	.32	52	.43
Mediterranean	382	.28	0	0	89	.21	210	.32	83	.34
Alaska	58	.21	15	.30	17	.15	18	.22	8	.34
North America	32	.19	7	.17	3	.04	13	.31	9	.58
Southwest Pacific	165	.14	17	.25	4	.02	59	.11	85	.22
Pacific Ocean Area	122	.12	2	.01	12	.04	75	.57	33	.16
Latin America	34	.10	8	.08	0	0	22	.26	4	.10

Source: Division of Medical Statistics, Office of The Surgeon General, War Department, Washington, D.C.



Table 7

Streptococcus Sore Throat

European Theater of Operations, U. S. Army

Cases and Rates per 1000 strength per annum

February 1944 to June 1945, Inclusive

Month	1944		1945	
	Cases	Rate	Cases	Rate
January			167	.85
February	142	2.02	201	.98
March	320	3.10	203	.77
April	272	2.93	113	.52
May	197	1.96	334	1.51
June	144	1.13	387	1.47
July	65	.60		
August	100	.79		
September	143	.87		
October	136	.98		
November	82	.54		
December	228	1.01		
Total	1829	1.24	1405	1.03

Source: Division of Medical Statistics, Office of  
The Surgeon General, War Department, Washington, D.C.





Table 8

Diphtheria in England and Wales

Rates per 100,000 population per annum

1939 to 1945, Inclusive

Year	Cases	Rate
1939	47698	115.0
1940	46281	110.6
1941	50797	121.7
1942	41404	98.8
1943	36077	85.6
1944	29446	69.4
1945	25000	58.9*

\*Based on 1944 population.

Source: Division of Medical Intelligence  
League of Nations reports.





Table 9

Diphtheria in Occupied Countries

Continental Europe

Rates per 100,000 population\* per annum

1939 to 1943 Inclusive

Country	1939	1940	1941	1942	1943
Germany (1939) 79,375,281	180.9	164.3	208.1	288.1	287.2
Greater Germany 95,162,000	183.8	179.7	215.3	295.0	295.3
Belguim (1941) 8,386,553	28.8	-	50.9	65.1	191.6
France (1942) 38,000,000	35.9	34.7	52.6	81.8	118.7
Denmark (1939) 3,805,000	29.1	22.6	23.1	42.6	66.4
Netherlands (1939) 8,728,569	14.6	19.8	63.6	222.7	638.9
Norway (1940) 2,937,000	1.83	4.7	88.9	284.3	752.8

\*Population figures given in the 1944 world almanac.

Source: Medical Intelligence Summary No. 8, Office  
Of The Chief Surgeon, European Theater of  
Operations, U. S. Army, 27 April 1944



Table 10

## Diphtheria

## European Theater of Operations, U. S. Army

Cases and rates per 1000 strength per annum, by months

February 1942 to June 1945 Inclusive

Month	Total		1942		1943		1944		1945	
	Cases	Rate	Cases	Rate	Cases	Rate	Cases	Rate	Cases	Rate
January	128	.48			7	.64	10	.16	111	.57
February	130	.46	0	0	3	.35	7	.10	120	.58
March	200	.53	3	3.80	0	0	20	.19	177	.67
April	245	.76	0	0	4	.38	11	.12	230	1.05
May	231	.69	1	.47	4	.42	4	.04	222	1.00
June	190	.47	2	.56	3	.25	8	.06	177	.67
July	15	.11	0	0	4	.21	11	.10		
August	17	.11	5	.57	2	.10	10	.08		
September	17	.09	5	.39	3	.13	9	.05		
October	30	.16	4	.24	4	.11	22	.16		
November	78	.38	11	.99	12	.29	55	.36		
December	96	.32	3	.32	14	.22	79	.35		
Total	1377	.43	34	.47	60	.23	246	.17	1037	.76

Source: Division of Medical Statistics, Office of The Surgeon General,  
War Department, Washington, D. C.





Table 11

Diphtheria

European Theater of Operations, U. S. Army

Cases and rates per 1000 strength per annum, by months

September 1944 to June 1945, Inclusive

	Total		United Kingdom		Continental Europe	
	Cases	Rates	Cases	Rates	Cases	Rates
1944 September	9	.05	5	.08	5	.04
October	22	.16	7	.17	15	.15
November	55	.36	8	.20	47	.42
December	79	.35	4	.07	75	.45
1945 January	111	.57	16	.32	95	.65
February	120	.58	10	.21	110	.69
March	177	.67	10	.20	167	.78
April	230	1.05	11	.28	219	1.22
May	222	1.00	33	1.10	189	.99
June	177	.67	4	.09	173	.80
Total	1202	.59	108	.23	1094	.69

Source: Division of Medical Statistics, Office of The  
Surgeon General, War Department, Washington, D.C.





Table 12

Diphtheria

Prisoners of War

European Theater of Operations, Continent Only  
Cases and rates per 1000 strength per annum, by months  
September 1944 to June 1945

Month	Cases	Rates
1944 September	4	1.6
October	27	4.7
November	82	5.3
December	86	6.7
1945 January	101	6.3
February	56	3.1
March	326	10.8
April	461	7.3
May	610	5.5
June	1106	5.9
Total	2859	6.2

Source: Division of Medical Records,  
Office of the Chief Surgeon,  
U.S. Army



Table 13

## Diphtheria

## Theaters of Operations of the U. S. Army

Cases and rates per 1000 strength per annum, by months

January 1942 to June 1945

Theater	Total		1942		1943		1944		1945	
	Cases	Rate	Cases	Rate	Cases	Rate	Cases	Rate	Cases	Rate
Total Army	4470	.21	188	.06	651	.10	1610	.21	2021	.52
Continental U. S.	830	.06	115	.05	182	.04	274	.07	259	.18
Total Overseas	3640	.45	73	.14	469	.29	1336	.38	1762	.72
Mediterranean	1143	.84	7	.33	211	.49	622	.94	303	1.26
Africa-Middle East	69	.53	2	.35	45	.84	14	.30	8	.33
Pacific Ocean Area	459	.44	10	.07	120	.41	312	.80	17	.08
European	1377	.43	34	.47	60	.23	246	.17	1037	.76
South West Pacific	456	.38	4	.06	10	.05	79	.14	363	.93
China-Burma-India	104	.31	3	.53	17	.37	53	.33	31	.26
Alaska	14	.05	3	.06	2	.02	6	.07	3	.13
Latin America	14	.04	9	.09	2	.02	3	.03	0	.0
North America	4	.02	1	.02	2	.03	1	.03	0	.0

Source: Division of Medical Statistics, Office of The Surgeon General,  
War Department, Washington, D. C.





Table 14

Vincent's Angina

European Theater of Operations, U. S. Army

Cases and rates per 1000 strength per annum, by months

February 1942 to June 1945 Inclusive

Month	Total		1942		1943		1944		1945	
	Cases	Rate	Cases	Rate	Cases	Rate	Cases	Rate	Cases	Rate
January	499	1.9			80	7.3	200	3.3	219	1.1
February	484	1.7	0	0	59	7.0	211	3.0	214	1.0
March	659	1.7	0	0	77	9.3	328	3.2	254	1.0
April	568	1.8	0	0	84	8.0	265	2.9	219	1.0
May	608	1.8	6	2.8	82	8.7	274	2.7	246	1.1
June	844	2.1	15	4.2	60	5.0	294	2.3	475	1.8
July	346	2.6	21	3.3	137	7.2	188	1.7		
August	357	2.3	25	2.9	112	5.8	220	1.7		
September	426	2.1	22	1.7	147	6.3	257	1.5		
October	462	2.4	39	2.3	191	5.2	232	1.7		
November	461	2.3	41	3.7	177	4.3	243	1.6		
December	605	2.0	32	3.4	258	4.0	315	1.4		
Total	6319	2.0	201	2.8	1464	5.5	3027	2.1	1627	1.2

Source: Division of Medical Statistics, Office of The Surgeon General,  
War Department, Washington, D. C.





Table 15

Meningococcus Meningitis

European Theater of Operations, U. S. Army

Cases and rates per 1000 strength per annum, by months

February 1942 to June 1945 Inclusive

Month	Total		1942		1943		1944		1945	
	Cases	Rate	Cases	Rate	Cases	Rate	Cases	Rate	Cases	Rate
January	194	.72			19	1.74	98	1.60	77	.39
February	245	.86	0		30	3.55	108	1.54	107	.52
March	361	.96	0		29	3.50	165	1.60	167	.63
April	286	.88	4	4.56	23	2.18	124	1.33	135	.62
May	251	.75	7	3.29	8	.85	151	1.50	85	.38
June	181	.45	6	1.69	9	.74	91	.72	75	.28
July	89	.66	6	.94	20	1.05	63	.58		
August	67	.43	9	1.03	11	.57	47	.37		
September	82	.41	8	.63	19	.81	55	.34		
October	99	.51	16	.96	27	.74	56	.40		
November	94	.46	12	1.08	39	.95	43	.28		
December	189	.63	28	3.00	85	1.31	76	.34		
Total	2138	.67	96	1.32	319	1.21	1077	.73	646	.47

Source: Medical Statistics Division, Office of The Surgeon General,  
War Department, Washington, D. C.



Table 16

**Meningococcus Meningitis**

Continental Europe and United Kingdom

European Theater of Operations, U. S. Army

Cases and rates per 1000 strength per annum, by months

September 1944 to June 1945 Inclusive

Month	Total		United Kingdom		Continental Europe	
	Cases	Rates	Cases	Rates	Cases	Rates
1944 September	55	.34	29	.44	26	.27
October	56	.40	31	.74	25	.26
November	43	.28	15	.37	28	.25
December	76	.34	38	.63	38	.23
1945 January	77	.39	28	.57	49	.33
February	107	.52	12	.25	95	.60
March	167	.63	23	.46	144	.67
April	135	.62	11	.28	124	.69
May	85	.38	12	.40	73	.38
June	75	.28	2	.04	73	.34
Total	876	.43	201	.43	675	.43

Source: Medical Statistics Division, Office of The Surgeon General, War Department, Washington, D.C.





Table 17

## Meningococcus Meningitis

Total Army, Continental United States and Theaters of Operations

Cases and rates per 1000 strength per annum

January 1942 to June 1945 Inclusive.

Theater	Total		1942		1943		1944		1945	
	Cases	Rate	Cases	Rate	Cases	Rate	Cases	Rate	Cases	Rate
Total Army	13836	.65	1065	.35	6903	1.03	4216	.56	1652	.43
Continental U. S.	10502	.80	860	.34	6184	1.20	2689	.67	769	.53
Total Overseas	3334	.41	205	.40	719	.45	1527	.44	883	.36
European	2138	.67	96	1.32	319	1.21	1077	.73	646	.47
South West Pacific	248	.21	44	.66	57	.29	76	.14	71	.18
China-Burma-India	92	.28	7	1.24	11	.24	42	.26	32	.26
North America	56	.33	6	.15	36	.50	12	.29	2	.13
Alaska	65	.24	17	.34	37	.32	9	.11	2	.09
Latin America	38	.11	17	.17	13	.11	6	.07	2	.05
Mediterranean	493	.36	2	.09	153	.35	241	.37	97	.40
African-Middle East	29	.22	1	.17	19	.36	5	.11	4	.17
Pacific Ocean Area	175	.17	15	.10	74	.25	59	.15	27	.13

Source: Medical Statistics Division, Office of The Surgeon General,  
War Department, Washington, D. C.





Table 18

## Tuberculosis

European Theater of Operations, U. S. Army

Cases and Rates per 1000 strength per annum, by months

February 1942 to June 1945, Inclusive

	Total		1942		1943		1944		1945	
	Cases	Rate	Cases	Rate	Cases	Rate	Cases	Rate	Cases	Rate
January	258	.96			14	1.28	117	1.90	127	.65
February	231	.81	0		22	2.60	66	.94	143	.69
March	265	.70	4	5.06	37	4.47	80	.77	144	.54
April	258	.80	0	0	27	2.55	63	.68	168	.27
May	363	1.09	1	.45	14	1.48	55	.55	293	1.32
June	271	.67	2	.56	28	2.31	82	.64	159	.60
July	69	.51	3	.47	13	.68	53	.49		
August	144	.93	8	.91	45	2.33	91	.72		
September	145	.73	14	1.11	30	1.29	101	.62		
October	108	.56	11	.66	30	.82	67	.48		
November	154	.75	17	1.53	42	1.03	95	.62		
December	178	.59	5	.54	45	.69	128	.56		
Total	2444	.77	65	.89	347	1.31	998	.68	1034	.75

Source: Medical Statistics Division, Office of The Surgeon General,  
War Department, Washington, D. C.



Table 19

**Tuberculosis**

**Continental Europe and United Kingdom**

**European Theater of Operations, U. S. Army**

**Cases and Rates per 1000 strength per annum, by months**

**September 1944 to June 1945, Inclusive**

Month	Total		United Kingdom		Continental Europe	
	Cases	Rates	Cases	Rates	Cases	Rates
1944 September	101	.62	70	1.06	31	.32
October	67	.48	43	1.02	24	.25
November	95	.62	36	.88	59	.53
December	128	.56	67	1.11	61	.37
1945 January	127	.65	53	1.08	74	.50
February	143	.69	44	.93	99	.62
March	144	.54	55	1.09	89	.42
April	168	.77	38	.98	130	.72
May	293	1.32	42	1.40	251	1.31
June	159	.60	35	.76	124	.57
Total	1425	.69	483	1.03	942	.60

Source: Medical Statistics Division, Office of The Surgeon General,  
War Department, Washington, D.C.





Table 20

Tuberculosis Survey  
European Theater of Operations, U. S. Army, 1943

	X-Rays Taken	Primary Tuberculosis				Reinfection Tuberculosis				Non-Tu-berculosis Pulmonary		Extra Pulmonary		Anoma-lies	
		Calcified Healed		Unstable		Apparently Healed		Active		Pulmonary		Pulmonary		lies	
		No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Survey I Groups A thru F (Feb. 1943)	3031	480	15.8	4	0.13	35	1.1	3	0.09	142	4.69	112	3.6	91	3.0
Survey II Groups G thru L (Oct. 1943)	3634	628	17.1	11	0.3	51	1.40	4	0.11	93	2.5	97	2.6	123	3.1
Survey III W.A.C.S (July 1943)	578	99	17.0	0	-	5	0.87	0	-	16	2.76	40	6.9	15	2.6
Total	7243	1207	16.0	15	0.21	91	1.3	7	0.09	251	3.4	249	3.4	229	3.1

Note: Percentages are based on total X-rays taken in each survey

Source: Annual Report, Division of Professional Services, Office of the Chief Surgeon, European Theater of Operations, U. S. Army, 1943





Table 21

**Tuberculosis Survey of British Civilians  
Employed by the European Theater of Operations, U. S. Army,  
Cases and Percent X-ray, 1942**

	Cases	Percent
<b>Total Chest X-rayed -- 586</b>		
Healed primary tuberculosis	71	12.50
Unstable primary tuberculosis	0	0.0
Reinfection type tuberculosis (total)	29	5.10
Minimal	23	4.10
Moderately advanced	5	0.90
Far advanced	1	0.17
Old Pleuritis	19	3.30

**Source:** Annual Report, Division of Professional Services,  
Office of the Chief Surgeon, European Theater of  
Operations, U. S. Army, 1944



Table 22

**Types of Tuberculosis in Nurses**

European Theater of Operations, U. S. Army

February 1942 to 31 May 1945, Inclusive

Types	Total		Cases			
	Cases	Percent	1942	1943	1944	1945
Pulmonary	50	69.4	0	3	17	30
Pleurisy with effusion	19	26.4	0	1	11	7
Other	3	4.2	0	0	2	1
Total	72	100.0	0	4	30	38

Source: Semi-annual Report on Tuberculosis Service, Office of the Chief Surgeon,  
European Theater of Operations, U. S. Army, June 1945





Table 23

Tuberculosis Survey of Officer Candidate School  
European Theater of Operations, U. S. Army,  
Cases and Rate per 1000, 1945

	Cases	Rate per 1000
Total candidates X-rayed -- 5240		
Active tuberculosis	2	0.38
Diffuse miliary calcification	4	0.76
Fibro-calcific scars	2	0.38
Doubtful parenchymal lesion	1	0.19

Source: Semi-annual report on Tuberculosis Service,  
Office of the Chief Surgeon, European Theater  
of Operations, U. S. Army, June 1945





Table 24

Tuberculosis in American Recovered  
Allied Military Personnel  
77th Field Hospital, European Theater of Operations,  
U. S. Army, Cases and Percent X-rayed, 1945

	Cases	Percent
Total X-ray -- 2750		
Pathology present	149	5.41
Atypical pneumonia	64	2.32
Lobar pneumonia	13	0.47
Pulmonary edema	4	0.14
Miscellaneous	43	1.59
Tuberculosis	16	0.58
Minimal	6	
Moderately advanced	6	
Apparently healed	4	
Pleural effusion (Tbc)	9	0.35
Total tuberculosis	25	0.91

Source: Semi-annual report on Tuberculosis Service, Office of  
The Chief Surgeon, European Theater of Operations,  
U. S. Army, June 1945



Table 25

## Tuberculosis

Total Army Continental United States and  
Theaters of Operation, U. S. Army

Cases and Rates per 1000 strength per annum  
January 1942 to June 1945, Inclusive

Theater	Total		1942		1943		1944		1945	
	Cases	Rate	Cases	Rate	Cases	Rate	Cases	Rate	Cases	Rate
Total Army	22,035	1.04	4,696	1.54	7,394	1.10	6,239	.83	3,706	.96
Continental U. S.	15,617	1.19	4,144	1.63	6,006	1.17	3,868	.96	1,599	1.11
Total Overseas	6,418	.80	552	1.08	1,388	.87	2,371	.68	2,107	.87
China-Burma-India	397	1.19	4	.71	68	1.48	231	1.45	94	.78
Africa-Middle East	141	1.08	8	1.39	78	1.46	40	.84	15	.63
Alaska	284	1.05	81	1.61	99	.86	70	.84	34	1.45
Latin America	311	.89	118	1.15	105	.87	60	.70	28	.72
Pacific Ocean Area	893	.85	126	.86	284	.96	282	.71	201	.97
Southwest Pacific	1,004	.83	108	1.61	96	.49	301	.54	499	1.28
North America	138	.81	37	.91	73	1.02	25	.59	3	.91
Europe	2,444	.77	65	.89	347	1.31	998	.68	1,034	.75

Source: Medical Statistics Division, Office of The Surgeon-General,  
War Department, Washington, D. C.





Table 26

## Measles

European Theater of Operations, U. S. Army

Cases and Rates per 1000 strength per annum, by months

February 1942 to June 1945 Inclusive

Month	Total		1942		1943		1944		1945	
	Cases	Rate	Cases	Rate	Cases	Rate	Cases	Rate	Cases	Rate
January	161	.60			25	2.28	67	1.09	69	.35
February	382	1.34			40	4.73	182	2.59	160	.78
March	893	2.37	11	13.92	49	5.91	415	4.02	418	1.58
April	772	2.39	11	12.54	31	2.93	482	5.19	248	1.13
May	491	1.47	17	7.98	32	3.39	251	2.50	191	.86
June	253	.62	12	3.38	53	4.37	95	.75	93	.35
July	60	.45	3	.47	29	1.52	28	.26		
August	22	.14	4	.46	2	.10	16	.13		
September	20	.10	1	.08	3	.13	16	.10		
October	18	.09	0	0	4	.11	14	.10		
November	27	.13	1	.09	6	.15	20	.13		
December	89	.30	7	.75	36	.55	46	.20		
Total	3188	1.00	67	.92	310	1.17	1632	1.11	1179	.86

Source; Medical Statistics Division, Office of the Surgeon General,  
War Department, Washington, D. C.





Table 27

Measles

United Kingdom and Continent

European Theater of Operations, U. S. Army

Cases and Rates per 1000 strength per annum, by months

September 1944 to June 1945, Inclusive

Month	Total		United Kingdom		Continental Europe	
	Cases	Rates	Cases	Rates	Cases	Rates
1944 September	16	.10	11	.17	5	.05
October	14	.10	8	.19	6	.06
November	20	.13	14	.34	6	.05
December	46	.20	25	.42	21	.13
1945 January	69	.35	34	.69	35	.24
February	160	.78	26	.55	134	.84
March	418	1.58	61	1.21	357	1.67
April	248	1.13	38	.98	210	1.17
May	191	.86	24	.80	167	.87
June	93	.35	9	.20	84	.39
Total	1275	.62	250	.53	1025	.65

Source: Medical Statistics Division, Office of The Surgeon General, Washington, D.C.



Table 28

## Measles

Total Army, Continental United States and

Theaters of Operations, U. S. Army

Cases and rates per 1000 strength per annum, by months

January 1942 to June 1945

Theater	Total		1942		1943		1944		1945	
	Cases	Rate	Cases	Rate	Cases	Rate	Cases	Rate	Cases	Rate
Total Army	75010	3.54	13830	4.53	40898	5.08	15170	2.02	5112	1.32
United States	68363	5.21	12718	5.01	39606	7.71	12823	3.20	3216	2.23
Total Overseas	6647	.83	1112	2.17	1292	.81	2347	.67	1896	.78
Latin America	752	2.16	245	2.38	85	.70	138	1.60	284	7.28
Alaska	443	1.63	223	4.44	151	1.31	62	.75	7	.30
North America	188	1.11	42	1.04	103	1.44	34	.81	9	.58
European	3188	1.00	67	.92	310	1.17	1632	1.11	1179	.86
Southwest Pacific	753	.62	430	6.41	154	.79	90	.16	79	.20
Mediterranean	689	.51	4	.19	356	.83	179	.27	150	.62
China-Burma-India	159	.48	6	1.07	27	.59	71	.45	55	.45
Africa-Middle East	53	.41	0	0	38	.71	3	.06	12	.50
Pacific Ocean Area	422	.40	95	.64	68	.23	138	.35	121	.58

Source: Medical Statistics Division, Office of The Surgeon General, War Department,  
Washington, D. C.





Table 29

## German Measles

## European Theater of Operations, U. S. Army

Cases and Rates per 1000 strength per annum, by months

February 1942 to June 1945, Inclusive

Month	Total		1942		1943		1944		1945	
	Cases	Rate	Cases	Rate	Cases	Rate	Cases	Rate	Cases	Rate
January	87	.32			3	.27	34	.55	50	.26
February	234	.82	0	0	9	1.06	61	.87	164	.80
March	751	1.99	6	7.59	42	5.07	230	2.23	473	1.79
April	848	2.62	18	20.52	40	3.78	474	5.10	316	1.44
May	496	1.49	28	13.15	38	4.03	282	2.81	148	.67
June	277	.68	27	7.60	34	2.80	156	1.23	60	.23
July	66	.49	13	2.03	20	1.05	33	.30		
August	28	.18	8	.91	1	.05	19	.15		
September	25	.13	5	.39	5	.21	15	.09		
October	28	.15	1	.06	4	.11	23	.17		
November	25	.12	2	.18	10	.24	13	.09		
December	39	.13	1	.11	15	.23	23	.10		
Total	2904	.91	109	1.50	221	.84	1363	.93	1211	.88

Source: Medical Statistics Division, Office of The Surgeon General,  
War Department, Washington, D. C.





Table 30

German Measles

Continental Europe and United Kingdom

European Theater of Operations, U. S. Army

Cases and Rates per 1000 strength per annum, by month

September 1944 to June 1945, Inclusive

Month	Total		United Kingdom		Continental Europe	
	Cases	Rates	Cases	Rates	Cases	Rates
1944 September	15	.09	7	.11	8	.08
October	23	.17	13	.31	10	.10
November	13	.09	4	.10	9	.08
December	23	.10	12	.20	11	.07
1945 January	50	.26	11	.22	39	.27
February	164	.80	24	.51	140	.88
March	473	1.79	68	1.35	405	1.89
April	316	1.44	41	1.06	275	1.53
May	148	.67	27	.90	121	.63
June	60	.23	5	.11	55	.25
Total	1285	.63	212	.45	1073	.68

Source: Medical Statistics Division, Office of The Surgeon General, War Department, Washington, D.C.



Table 31

## German Measles

Total Army, Continental United States and

Theaters of Operation, U. S. Army

Cases and Rates per 1000 strength per annum

January 1942 to June 1945, Inclusive

Theater	Total		1942		1943		1944		1945	
	Cases	Rate	Cases	Rate	Cases	Rate	Cases	Rate	Cases	Rate
Total Army	*	*	*	*	79634	11.84	13422	1.79	10257	2.65
United States	*	*	*	*	77736	15.14	11058	2.76	8098	5.60
Total Overseas	7484	.93	1063	2.07	1898	1.19	2364	.68	2159	.89
Latin America	1561	4.48	308	2.99	162	1.34	541	6.29	550	14.10
Mediterranean	420	.31	0	0	192	.45	106	.16	122	.51
Alaska	655	2.41	162	3.22	476	4.14	14	.17	3	.13
North America	272	1.60	36	.89	217	3.03	13	.31	6	.39
Europe	2904	.91	109	1.50	221	.84	1363	.93	1211	.88
Southwest Pacific	831	.69	248	3.70	400	2.05	132	.24	51	.13
Pacific Ocean Area	600	.57	176	1.19	162	.55	115	.29	147	.71
China-Burma-India	181	.54	23	4.09	49	1.06	58	.36	51	.42
Africa-Middle East	60	.46	1	.17	19	.36	22	.46	18	.75

\*Data not available

Source: Medical Statistics Division, Office of The Surgeon General  
War Department, Washington, D. C.





**Table 52**

**Mmps**

**European Theater of Operations, U. S. Army**

**Cases and Rates per 1000 strength per annum, by months**

**February 1942 to June 1945, Inclusive**

Month	Total		1942		1943		1944		1945	
	Cases	Rate	Cases	Rate	Cases	Rate	Cases	Rate	Cases	Rate
January	792	2.95			51	4.66	301	4.90	440	2.25
February	1059	3.72	5	16.21	52	6.15	413	5.87	589	2.86
March	2026	5.38	1	1.27	47	5.67	1041	10.08	937	3.54
April	1948	6.03	13	14.82	67	6.34	1204	12.95	664	3.03
May	1605	4.81	10	4.70	55	5.83	985	9.80	555	2.50
June	1067	2.63	19	5.35	55	4.54	761	5.98	232	.88
July	326	2.42	16	2.50	75	3.92	235	2.16		
August	235	1.52	26	2.96	57	2.95	152	1.20		
September	160	.80	17	1.34	46	1.97	197	.59		
October	220	1.14	24	1.43	104	2.84	192	.66		
November	300	1.47	26	2.33	153	3.73	121	.79		
December	525	1.74	34	3.64	236	3.63	255	1.13		
Total	10263	3.23	191	2.63	998	3.78	5657	3.84	3417	2.49

Source: Medical Statistics Division, Office of The Surgeon General  
War Department, Washington, D. C.





Table 33

Mumps

Continental Europe and United Kingdom

European Theater of Operations, U. S. Army  
Cases and Rates for Troops Serving in the United  
Kingdom and on the Continent  
September 1944 to June 1945,  
Inclusive

Month	Total		United Kingdom		Continental Europe	
	Cases	Rates	Cases	Rates	Cases	Rates
1944 September	97	.59	81	1.23	16	.16
October	92	.66	55	1.32	37	.38
November	121	.79	82	2.00	39	.35
December	255	1.13	187	3.11	68	.41
1945 January	440	2.25	281	5.70	159	1.08
February	589	2.86	268	5.67	321	2.02
March	937	3.54	261	5.17	676	3.16
April	664	3.03	144	3.72	520	2.89
May	555	2.50	130	4.35	425	2.22
June	232	.88	60	1.30	172	.79
Total	3982	1.94	1549	3.29	2433	1.54

Source: Medical Statistics Division, Office of The Surgeon  
General, War Department, Washington, D.C.



**Table 34**

**Mumps**

**Total Army, Continental United States and**

**Theaters of Operations, U. S. Army**

**Cases and Rates per 1000 strength per annum**

**January 1942 to June 1945, Inclusive**

Theater	Total		1942		1943		1944		1945	
	Cases	Rate	Cases	Rate	Cases	Rate	Cases	Rate	Cases	Rate
Total Army	101359	4.79	17893	5.86	40855	6.07	27098	3.61	15513	4.00
United States	83076	6.33	15351	6.05	37270	7.26	19665	4.90	10790	7.47
Total Overseas	18283	2.27	2542	4.95	3585	2.25	7433	2.12	4723	1.94
Alaska	1114	4.10	541	10.77	530	4.61	26	.31	17	.73
North America	605	3.56	171	4.22	362	5.05	39	.93	33	2.13
Europe	10263	3.23	191	2.63	998	3.78	5657	3.84	3417	2.49
Africa-Middle East	335	2.57	10	1.74	197	3.69	86	1.82	42	1.76
Latin America	832	2.39	615	5.98	89	.74	105	1.22	23	.59
China-Burma-India	528	1.59	16	2.84	45	.98	224	1.40	243	2.01
Southwest Pacific	1733	1.44	621	9.26	371	1.90	366	.66	375	.96
Pacific Ocean Area	1276	1.22	218	1.48	421	1.43	345	.87	292	1.41
Mediterranean	1597	1.18	159	7.46	572	1.33	585	.89	281	1.17

Source: Division of Medical Statistics, Office of The Surgeon General,  
War Department, Washington, D. C.





Table 35

Smallpox

Total Army, Continental United States and  
Theaters of Operations, U. S. Army  
Cases and Rates per 1000 strength per annum  
January 1942 to June 1945, Inclusive

Theater	Cases	Rates
Total Army	89	.004
United States	10	.001
Overseas	79	.010
China-Burma-India	36	.108
Africa-Middle East	23	.176
Mediterranean	13	.010
Latin America	4	*
Alaska	2	*
Europe	1	*
Southwest Pacific	0	-
Pacific Ocean Area	0	*
North America	0	-

\* Rate not calculated

Source: Division of Medical Records,  
Office of the Chief Surgeon  
European Theater of Operations.





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### Epidemiologic Case Reports

1. Mumps aboard transport and introduced into units to which recruits came as replacements.



A HISTORY OF PREVENTIVE MEDICINE  
IN THE  
EUROPEAN THEATER OF OPERATIONS  
UNITED STATES ARMY  
1941 - 1945

PART III - Epidemiology  
Section 5 - Arthropod Borne Disease  
Number 1 - Typhus Fever

by

Colonel John E. Gordon, M.C.  
Chief of the Division of Preventive Medicine  
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## PART III

### Epidemiology

#### Section 5 - Arthropod Borne Disease

##### Number 1 - Typhus Fever

Typhus Fever.--Epidemic louse-borne typhus fever has always developed its greatest potentialities under conditions of war and famine. Medical intelligence summaries of the Office of the Chief Surgeon, ETOUSA, medical notes of the health division of UNRRA, and the weekly epidemiological records of the Health Section of the Secretariat of the League of Nations all served to reveal that typhus fever became established in Germany in 1939. These reports continued thereafter to give pertinent facts about its incidence and its distribution. No question existed that typhus would be encountered in Germany when the U.S. Army entered that country in the early spring of 1945. The important consideration which faced Army medical authorities was how much typhus would be uncovered and where it would be found.

Typhus in the German Reich, 1939 to The Allied Invasion.--The primary European focus of louse-borne typhus for many years--and very likely for centuries--has been in the states of Eastern Europe; in Russia, Poland, and the Balkans. Other recognized European endemic foci are in the Iberian peninsula and in Eire, neither of which had an influence on areas occupied by the United States Army.

Typhus first appeared in Germany in 1939, at which time eight cases were reported. The source of infection was Russia, but the exact geographical origin within that country was not determined. Epidemic typhus had long been prevalent in many parts of Russia, particularly in White Russia and the Ukraine, but no detailed nor reliable information was available during the war years as to its distribution and incidence.

Distribution and Spread in Germany.--Six isolated cases of typhus occurred in 1940 among civilians of the original 1919 territory of Germany. The geographical location was not given in available reports but all cases were reported to be the result of importation of the disease from Russia.

In the years that followed, the number of cases increased sharply and the disease was scattered throughout Germany. This was the direct result of the importation of infection from Poland and Russia by the German armed forces, by prisoners of war and by conscript labor from endemic typhus fever areas. In spite of delousing measures, the primitive conditions under which conscript laborers



were compelled to live made it impossible to keep them free of lice. Undernutrition may have activated latent typhus infection. At any rate, there were many outbreaks of typhus fever in prison camps; and sometimes the disease extended to the native German population. The essential freedom from lice of most Germans prevented extension of the infection to epidemic proportions. Cases were nevertheless sufficiently numerous that German health authorities began systematically to delay publication of information concerning typhus fever, and stopped announcements altogether after January 1944.

By 1941, typhus was rampant. A total of 2,351 cases were reported for that year in Greater Germany, which included Germany proper and the annexed territories, principally Poland. The German Reich had 395 cases and 1946 were in the annexed territories. The distribution was not uniform; but it was known that 44 of the 74 administrative districts in Germany were affected. The incidence was greatest in the eastern part of Germany, less in the central part and least in the western and southern districts. As might be expected, the most heavily infected administrative divisions were those into which Polish territory had been incorporated. The number of known cases by population districts is presented in Table 1. The data are incomplete and represent only a part of the cases reported in 1941, the geographic distribution of the remainder being unavailable.

The reported typhus for 1942 was 2742 cases. A greater increase over the previous year would have been anticipated, since conditions inside Germany were steadily deteriorating. The explanation apparently lies in the action of the German Government in suppressing reports of the disease because of the morale factor. Of the 2742 cases, 2400 were reported from Germany proper, while only 342 were from the annexed territories. The distribution differed significantly from that of 1941, when most cases were from the annexed territories.

Typhus in 1942 predominated in the large industrial areas of Germany, where many foreign conscript laborers were employed. In the course of the year, 53 of the 74 administrative districts were affected. The distribution was more uniform and more widespread than in the previous year, with typhus occurring even in northwest Germany. The districts reporting typhus and the numbers of cases in 1942 are presented in Table 2.

The United States Public Health Reports set the total number of typhus fever cases in Germany in 1943 at 5,058. This probably represents the most accurate annual report on typhus in Germany up to that time. The disease continued to appear in the heavily populated industrial areas, and the general geographic distribution remained widespread. Table 3 gives the number of cases reported by German health authorities by districts for 1943.

The annual distribution of typhus fever for the period 1939 to 1945 for Germany and annexed territory is presented in Figure 1, Table 4. The data for Germany proper as compiled by the League of Nations are illustrated in Figure 2.

The above facts show that typhus in Germany was at first fairly well localized in the eastern part of the country, where infected Polish and Russian prisoners of war were interned. It subsequently spread in a centrifugal manner to the adjacent German population. When industrial activities were more or less consolidated within the inner areas of the country and as more foreign laborers moved into these crowded areas, the major foci of typhus infection shifted to these localities. The typhus problem thereafter was serious.

Typhus spread to all principal regions of Germany and became epidemic in some areas. Considering the frequency with which new infections were introduced, control measures would appear to have been good, in that typhus was held to reasonably low levels. The final debacle of the war led to conditions marked by disorganization and great shifts of population of such extent that the epidemic potential was extremely dangerous when American troops entered the country.

Incidence by Population Groups.--The first typhus in Germany was among Polish and Russian prisoners of war and conscript laborers (displaced persons). As typhus increased, the displaced persons still accounted for the majority of infections, with the remainder occurring among prisoners of war and German civilians. This can be explained by the unsanitary and crowded living conditions of the displaced persons group, which presumably led to heavy louse infestation. Their resistance to disease was also undoubtedly lowered as a result of long hours of labor and insufficient food. As a rule, louse infestation was not common among German civilians. Official records showing the incidence of typhus among German soldiers are not available; but typhus did occur in the German army and in some instances in epidemic proportions. In 1941 a fairly serious outbreak appeared among troops stationed on the Russian front. Naturally the German high command found it convenient to suppress reporting of the disease in the armies. Figure 3, Table 5 presents data on the distribution of typhus by population groups for the years 1942 and 1943.

Mortality.--The case fatality from typhus was much higher in German than in non-German groups despite the lowered resistance of the latter and presumably the inferior medical care they received. The explanation is not wholly apparent. The non-German group consisted of a great many Poles and Russians, who might be expected to possess some degree of acquired immunity as a result of the excess incidence of typhus in those countries for so many years. (Figure 3).



Typhus in the Rhineland.--In the latter part of 1944 and the early months of 1945, typhus apparently appeared for the first time in significant numbers in the Rhineland section of Germany. This was of importance to military authorities of the United States because plans called for our troops to enter Germany through this area in the early spring of 1945.

German Program for Typhus Control.--Although the German government made every effort to control the spread of typhus in Germany, their control program as a whole served only to keep the disease within reasonable limits. That of itself was no mean accomplishment, because many factors in Germany favored transmission. The shifting of displaced foreign workers from place to place, the crowded living condition in air raid shelters and industrial areas, the insanitary conditions in cities as a result of frequent bombings and the resultant louse infestation gave rise to situations about which the Germans could do little. Furthermore the infectious agent was repeatedly reintroduced from foreign sources.

Louse Control Measures.--Louse infestation was prevalent among the displaced foreign workers, and according to report little was done toward delousing them until typhus actually was present. Even then delousing facilities were inadequate and to a great extent ineffective. Information also indicated an increase in louse infestation of German troops, particularly toward the end of the war.

Delousing had always been a problem in the German army. The German soldier found proper delousing facilities only after his unit had been withdrawn from the front, with the result that he was fortunate to obtain delousing treatment once in six months. The louse-icide powder available to German troops was considered ineffective and had an offensive odor. Furthermore it was not of general issue.

Louse infestation in the camps holding allied prisoners of war was also heavy, and adequate delousing facilities non-existent. The German civilian was probably the most louse-free group in Germany, since his bathing facilities and living conditions as a rule continued good.

Vaccination.--Vaccination against typhus was the exception rather than the rule in Germany, even in the German army itself. In 1942 the United States Office of War Information stated the reason most of the German forces were unvaccinated was that the German laboratories for typhus research had failed to develop mass production of vaccine. The two vaccines developed by Hermann Eir, the German typhus research expert, were too complicated for mass production, although laboratories for the production of typhus vaccine were established in Berlin, Riga and Cracow.

Reports indicate that two kinds of vaccine were made, one from chick embryo and the other from lungs of mice experimentally



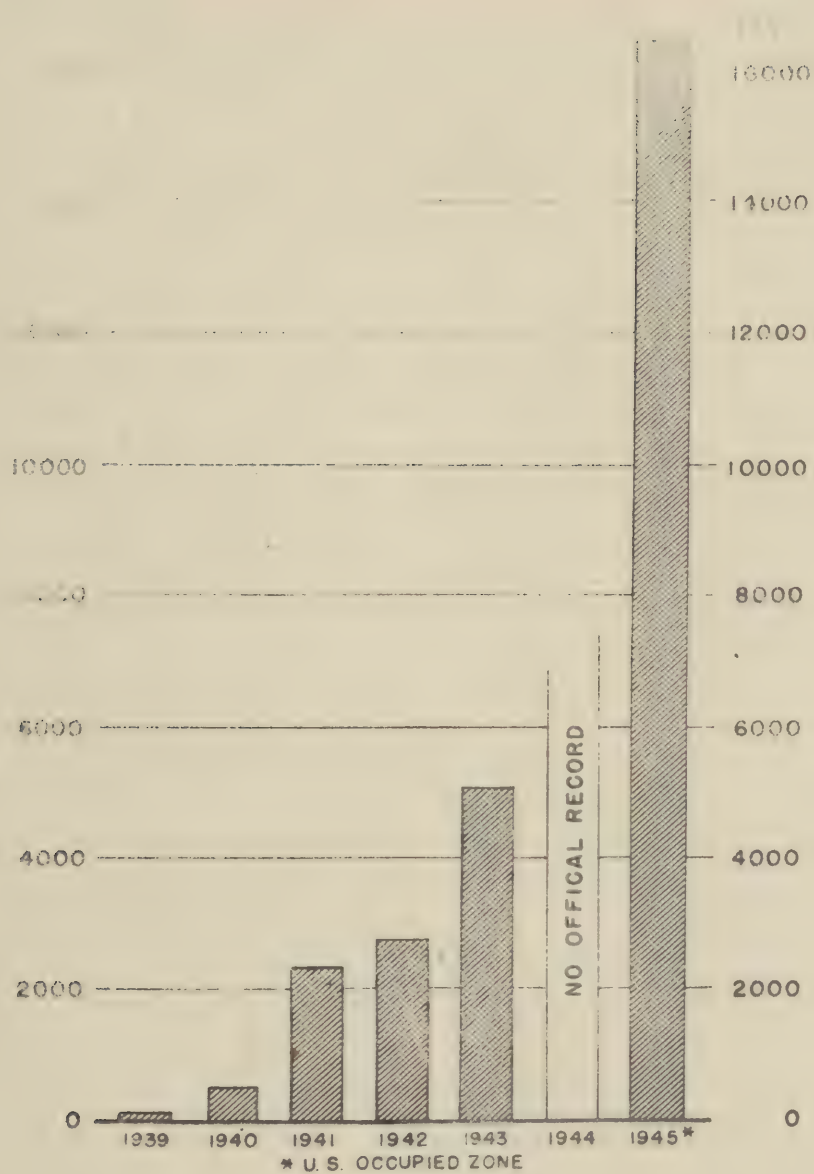


Figure 1

Typhus fever in Germany and annexed territory,  
by years, January 1939 to June 1945.



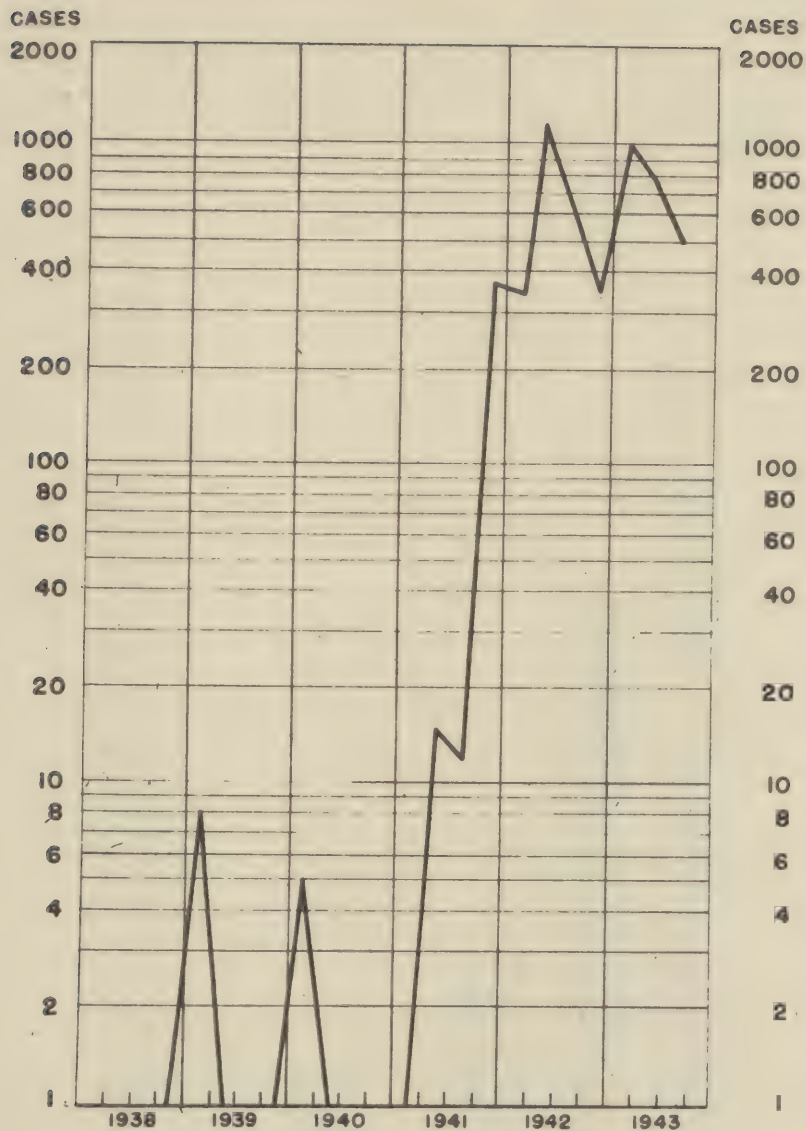


Figure 2

Trend of typhus fever in Germany, number of cases by quarters, 1938 to 1943.





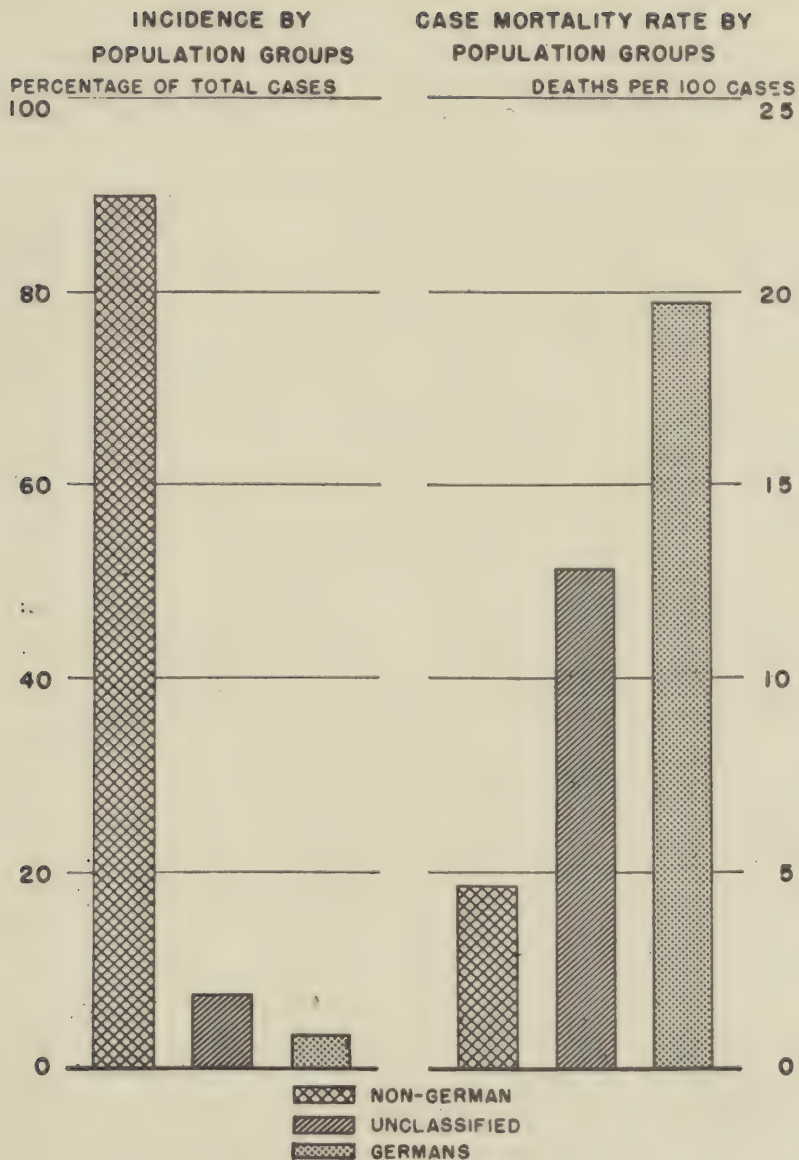


Figure 3

Typhus fever in Germany, elements of population affected and mortality rates, by years, 1942 to 1943.





infected with Rickettsia. Vaccine was available only for those individuals who were most apt to come in contact with the disease, such as doctors, nurses, medical department personnel and workers in delousing centers. It was available to soldiers over 38 years of age, to high ranking army officers, and rather generally for the Luftwaffe. The Weigl vaccine had limited application because of the technical difficulties in its production.

Medical care.--Medical care of patients with typhus fever in German hospitals was for the most part good. Special wards were set aside in hospitals where necessary; and in epidemic areas typhus fever hospitals were constituted. The exception to this was in the concentration camps where medical care was decidedly inadequate and in many instances disgraceful.

Development of Measures and Methods for Typhus Control.--The program of the United States army for control of typhus fever in Europe was based on the cardinal principle of education. As many individuals as possible were acquainted with the causes of the disease and the methods for its prevention. A comprehensive program gave attention to six major considerations:

- a. An adequate system of reporting cases of typhus fever in all population groups involved. Satisfactory procedures already existed in respect to military personnel of the U. S. Army and to prisoners of war. Reporting of the disease among displaced persons and German civilians required special consideration and methods.
- b. A system of case finding, employing the epidemiological method for prompt discovery of new cases and the existence of newly developing foci of infection.
- c. Provision for isolation and hospital care of patients with typhus fever.
- d. The establishment of a policy in respect to quarantine of highly infected areas or camps; and the institution of a cordon sanitaire to protect larger districts relatively free of typhus from infection transmitted from areas of high endemicity or actual epidemic.
- e. Delousing of patients, contacts and at times of large segments of the normal population, particularly of camps and of highly infected villages; the use of DDT powder to be the standard procedure.
- f. Specific protection by immunization of all military personnel, of those civilians intimately concerned with typhus control, of intimate contacts, and as determined by circumstances, of large population groups such as inmates of concentration camps.

Training in Methods of Typhus Control.--Since the prevention of the disease among military personnel exerts such an important influence on the success of military operations, the first objective was the thorough indoctrination of officers and men of the armies on the hazards of the disease and the methods of protecting troops against infection. Special stress was placed on the louse and the methods for control of infestation by lice; particularly on the technics for personnel protection and for mass delousing. The effort to this end was instituted long in advance of any possible exposure of an American soldier.

Training in the United Kingdom.--Training in the United Kingdom in the early unorganized days of 1942, and later in the year when preparations for the North African invasion got under way, included little more than informal discussion with individual units. Most of those destined for Africa were reached, and because the number of troops was not great, indoctrination was believed to have been satisfactorily accomplished.

The first organized instruction was initiated in the spring of 1943, with the opening of the Field Service School at Shrivenham, England. Here medical officers and nurses were taught technical methods by means of lectures, motion pictures, and the demonstration of materials and equipment. The school continued for several months after the Normandy invasion and medical officers of all branches of the service were trained in the subject.

In addition to the instruction of medical officers and nurses at the Field Service School, a special course on typhus control was given to the representatives of units then in the United Kingdom, including officers of the line, of the Quartermaster Corps and of the Medical Corps, with the intent that those specially trained officers would constitute the instructors for the military personnel in general. That all personnel might be informed of the methods of typhus prevention and control, detailed instructions were issued by directive.

As the time for the Normandy invasion approached, troops were specifically briefed on the subject of typhus at the marshalling areas just prior to embarkation for the Continent, and each soldier was issued a can of louse powder.

Other educational work consisted of the circulation of motion picture films, the publication of popular articles in army periodicals, and informative circular letters and directives by the Office of the Chief Surgeon and by command headquarters.

Quartermaster Sterilization Companies and Fumigation and Bath Units were given first hand and personal instruction in the use of their materials and equipment in the control of lice.



A group of officers from ETOUSA was sent to North Africa, Italy and Egypt during the winter of 1943-44 to study the methods of typhus control practiced in those countries. As a result of their observations, the members of the mission were of the opinion that the conditions which caused the Naples epidemic would inevitably be duplicated in other parts of Europe as military operations were extended to the Continent. The mission recommended that a special type of organization, to be called Typhus Control Units, be established in the European Theater to initiate control operations and to coordinate the activities of civil and military organizations immediately on the development of an epidemic. Scarcity of medical officers and enlisted personnel to staff such units prevented their immediate organization.

The control of typhus among civilians of liberated countries and among displaced nationals was an accepted and direct responsibility of G-5 Civil Affairs and Military Government. The organization of this branch was so incomplete prior to D-Day that it was impossible to introduce into their program a thorough course of instruction in methods of typhus control. Nevertheless, through the cooperation of the United States of American Typhus Commission and the Division of Preventive Medicine of the Office of The Chief Surgeon it was possible to bring a certain measure of instruction on modern methods for attacking the disease to American, British, French, Dutch and other personnel in Great Britain who were to be concerned with civil affairs in continental Europe.

Training in Typhus Control on the Continent.---The character of military operations in France from D-Day to November 1944 precluded further organized and general instruction of troops in forward areas on the prevention of typhus. Information was acquired shortly after the landing in Normandy that typhus had occurred near Cherbourg among German Todt workers as late as May 1944, and German prisoners captured in the Normandy campaign were in many instances infested with lice. Temporary arrangements were made to manage a possible epidemic.

During July 1944, two delousing teams were organized in each Quartermaster Sterilization Company then on the Continent. The teams consisted of five enlisted men with a non-commissioned officer in charge, and were equipped with one 6 x 6 truck, an initial issue of 400 pounds of DDT powder and twelve hand dusters. The staff was trained in delousing and the relation of that procedure to the control of typhus. They remained at their assigned duties but were on call by the Office of the Chief Surgeon should typhus fever appear among civilian or military populations.

The organization of these teams was possible through the close cooperation of the Office of The Chief Surgeon and the Quartermaster, Advance Section, Communications Zone. Later in the year,



Advance Section trained the entire personnel of its Sterilization Companies in delousing and typhus control work, a circumstance which contributed greatly to the satisfactory performance of control measures when typhus became epidemic the following spring.

With ever growing evidence that typhus would be encountered among civilians and displaced persons in Germany, and since control of the disease in such groups had been delegated to G-5, Public Health Section, the Surgeon of the Twelfth Army Group requested the assistance of the theater Preventive Medicine Service in organizing and training G-5 personnel of the Armies in typhus control.

Initiated in September 1944, the training consisted in acquainting G-5 public health officers of the Armies with all aspects of the problem, and in instructing ECAD units in actual control measures. A standard plan was developed for use by Armies in stamping out the disease wherever it might be found and for preventing its spread from endemic areas in Germany to other countries of Western Europe. The United States of America Typhus Commission undertook a similar program with 21st Army Group, and later with the Preventive Medicine Service in the Sixth Army Group.

In addition, other staff members of the Typhus Commission were engaged during the summer and early fall of 1944 in training French civilian and military personnel in typhus control methods.

Immunization against Typhus Fever. -- Troops stationed in the United Kingdom in the early days of the theater were routinely given three 1 cc injections of typhus vaccine as an initial immunization, followed by a 1 cc stimulating dose at yearly intervals. In preparation for D-Day, all individuals who had no record of immunization against typhus since 1 July 1943 were reimmunized. On 15 March 1944, typhus immunization had been brought to the following status: Ground Forces 99% immunized, Air Forces 96% and Communications Zone 98%.

Further provision was made that an additional 1 cc. of typhus vaccine was to be administered every four to six months in the presence of serious danger of infection. Following instructions from the War Department, two injections of 1 cc each was adopted as standard practice for initial immunization in January 1945.

In preparation for the Spring campaign of 1945, all troops who had had no typhus vaccine since 15 September 1944 were reimmunized between 1 December and 20 December 1944. Reimmunization on 1 November 1944 had been considered, but because of the favorable typhus situation in France, delay until shortly prior to entry into Germany was deemed advisable. No case of typhus had occurred in France since the occupation of that country, and indeed none was subsequently reported until two cases developed among Russian displaced persons at La Courtine during the latter part of February 1945.

Intelligence reports indicated an entirely different situation in Germany. Repeated reference was made to outbreaks of typhus in all sections of the Reich. It was thus highly desirable that troops should have maximum immunity during the peak of the typhus season, January through March, and at the time of the invasion of Germany.

Plans were made to reimmunize all troops again on 1 April 1945, if the situation warranted. No such immunization ever became necessary, although reimmunization in March and succeeding months was widely practiced and directed for all personnel connected with typhus fever control.

#### Procurement of Supplies.

DDT Powder.--The use of DDT powder was early decided upon as the most practical method for controlling the louse vector of typhus fever. The timely provision of adequate stocks of this insecticide and the necessary equipment for applying it was a major supply problem. This was particularly true in 1944, when intensive military operations required the use of all available transport for essential war material. It was not possible to stock typhus control materials on the continent in preparation for the inevitable need, but as a substitute all agencies acted energetically to accumulate large stock piles in Great Britain.

Fortunately, the areas on the continent first occupied by Allied troops and later at the critical point of the tactical situation in December were free from typhus even during the usual peak of the typhus season. Not until the advance across the Roer River in February 1945 was the full impact of the disease made manifest. Its control then became an essential factor in military operations. The unprecedented magnitude of the problem that was suddenly forced upon the armies led to much higher shipping priority for typhus control supplies than had previously been enjoyed.

By the time supplies were needed, ample quantities were available on the continent. From an insignificant monthly demand for about 3.5 tons of DDT powder in January 1945 by G-5 of the armies, the requirements jumped to approximately 150 tons by the following April 1945. Through the cooperation of G-5, SHAEF, the Chief Quartermaster Theater and the Medical Supply Division of the Office of the Chief Surgeon, 756,000 pounds of DDT powder were provided for continental use from 1 January to 31 May 1945. Of this amount 525,000 pounds of powder were issued to units concerned with typhus control.

The problems of supply just presented related only to intra-theater effort and concern. Particular commendation is due the Service of Preventive Medicine in the Office of the Surgeon



General and the Director of the U.S.A. Typhus Commission in Washington for the diligence and effort exercised at the sources of supply, which made possible long in advance of need the huge stock piles accumulated in the United Kingdom. One of the most satisfactory features of typhus control as it developed in Germany was that never in the course of operations did a shortage of dusting powder exist.

Hand Dusters, Powder Dusters, 2-ounce Sifter cans.--The common method of applying DDT powder was by hand dusters. They were issued to all units concerned with the delousing of civilians. Due to a shortage in the United States of the better quality of Dobbins and Hudson dusters, only the small Hudson Cadet type was available in the theater. A small number of these guns were provided by the Chief Quartermaster from military stocks for the early control work among civilians. The deficiency was eliminated in December 1944 by the shipment of 1800 better type dusters by air from the Zone of the Interior at the urgent request of G-5, SHAEF. From 1 January to 31 May 1945, G-5 supplied an additional 3,700 dusters and the Quartermaster provided 6,800 during the period from March to June 1945.

The uncovering of large forced labor camps in Germany and the placing into operation of the cordon sanitaire required the rapid delousing of large numbers of persons. Through the cooperation of the U.S.A. Typhus Commission, G-5 SHAEF was able to secure 34 powder dusters which were shipped by air to the theater to supplement the nine on hand.

Although Quartermaster stocks of 2-ounce sifter cans were in ample supply and were available for emergency civilian needs, actually only two to three thousand cans were used for this purpose. They were the principal reliance for preventive delousing of troops.

Typhus Vaccine.--The original supply plan for typhus vaccine in epidemic control placed the responsibility for military needs on the Supply Division of the Office of The Chief Surgeon. The United States of America Typhus Commission established a separate stockpile to be drawn upon by Civil Affairs groups, SHAEF Missions, public health representatives of European governments in exile, UNRRA and similar organizations.

It soon became evident that distribution of typhus vaccine from a single source to all using agencies including the United States Army, would avoid waste and accumulation of surplus stocks. Decision was therefore taken that henceforth the Typhus Commission would be responsible for the overall supply of typhus vaccine to the theater.

In accordance with this arrangement vaccine was shipped to United States Army medical supply depots in Great Britain and the



Continent from the warehouses of the Commission in London and Paris, for distribution to all using agencies. As in the case of DDT powder, supplies always exceeded demand and permitted wider practice of control through specific immunization than was originally planned.

Cordon Sanitaire.--The policy of local quarantine of infected areas was adopted as an integral part of the projected plan for control of typhus. The details as to area, extent and procedure necessarily rested on immediate epidemiologic circumstances and could not be determined in advance.

A detailed plan for a cordon sanitaire was prepared in late 1943. It was apparent even then that the Rhine River would constitute an important factor in military operations and that progress in all likelihood would be held up there temporarily. The most reliable medical intelligence indicated that relatively little typhus existed west of the river but that the east bank and from there north and east was heavily infected.

The general plan for typhus control, determined almost two years in advance of operations provided for prompt establishment of a cordon sanitaire, extending from Switzerland to the sea along the Rhine and Waal rivers to be put into effect as the West Rhineland was occupied. A strong effort was to be made to clear the Rhineland of such typhus as might exist there; and by the cordon sanitaire to protect France, the other liberated countries, and the United Kingdom from invasion by the disease.

Case Finding Teams.--The usefulness of small groups charged with the search for cases and the institution of emergency control measures among immediate contacts in newly discovered foci of infection, has long been demonstrated a valuable method in general epidemiologic practice. It had served well in other outbreaks of typhus fever.

A plan for case finding teams to include a medical officer, a sanitary corps officer and the necessary transportation was formulated early in 1944 on recommendation of the observers from the Office of the Chief Surgeon sent to the Naples outbreak of 1943-44. The teams were activated on recognition of typhus as an epidemic problem in Germany.

The Technical Details of Typhus Control.--The prevention of typhus fever among troops of the United States Army was based on the principle that the most logical way to attain that objective was to provide them with an environment as nearly free from typhus as possible. That involved the help of the Army in the control of typhus fever among civilians in areas where the troops were operating. The actual plan for control was formulated on that guiding principle and was built around the measures just described.

The protocol for action now to be presented was designed in general form far in advance of contact with typhus, but the details of procedure very naturally took new form as experience accumulated and the various methods found opportunity for evaluation. The plan as presented consequently represents methods and procedures tested by use in the most severe outbreak of louse borne typhus in recent years.

Field problems in typhus control may be said to fit within the fabric of three basic situations. The first is that presented by entrance or contemplated entrance of susceptible persons into a recognized endemic typhus area, or into a region where current information indicates likely invasion. Typhus fever is not present; the threat of typhus is.

The second general situation is that where typhus has made itself manifest in the form of isolated cases or in small groupings of cases; where there exists the beginning or the potentiality of an epidemic. This is the critical situation where the future extent of the disease is largely determined by the promptness and thoroughness of the action instituted.

The third situation is that of a full blown epidemic; where the first word of the disease is that of an epidemic already under way. Because of the places in which typhus occurs and the circumstances under which it arises, that is not uncommon. The plaques of the world most commonly affect populations with underdeveloped health organizations, limited facilities for combating epidemics, a paucity of trained personnel and rudimentary systems of disease reporting.

#### Preventive Measures to be Instituted in Advance of Known Typhus.

Immunization.---Immunization against typhus is required of all military personnel and is recommended for all foreign residents of the area. The initial vaccination consists of two subcutaneous injections of typhus vaccine, 1 cc. each, at a seven day interval. Re-immunization by injection of a stimulating dose of 1 cc in November and February is required of troops subjected to special hazard.

Prevention of Lousiness among Troops.---Insecticide powder, louse, DDT (QM Stock No 51-1-173) 2 ounce can, is provided each man. The weekly use of the powder on the under-clothing and inner surfaces of shirt and trousers is encouraged. Inspection of men and quarters should be practiced every two weeks to insure freedom from lice.

Information on Epidemics.---Close liaison should be maintained by unit surgeons with local military government and



civilian public health authorities to assure early information of the presence of typhus.

Supply.--Timely requisition of supplies essential to control of typhus fever.

Training of Control Teams.--Case Finding and Insect Control Teams need special training in delousing procedures and in the special measures for typhus control.

Refugees.--The processing of displaced persons, refugees, and repatriates from typhus endemic regions should include physical inspection for signs of the disease and assurance that they are free from lice.

### Control Measures - Sporadic or Endemic Typhus.

Diagnosis.--Clinical diagnosis should be confirmed by a rise in titer of agglutinins to B. proteus OX19. The macroscopic slide agglutination test using B. proteus OX19 antigen has proved to be a valuable field method under epidemic conditions.

Isolation.--Patients with typhus fever should be isolated under accepted conditions of isolation technic. If the number of patients warrants, special isolation wards are desirable. No patient will be admitted to an isolation ward still harboring lice. Preliminary bath, clean clothes and disinfection with DDT powder are essential. Discarded clothing must be disinfected by steam sterilization or soaked in cresol solution. All attendants must be immunized with typhus vaccine. Continuous freedom from lice is to be assured by daily use of DDT powder.

Foreign Quarantine.--Military patients to be transported to other countries must be certified free of lice; and other military personnel will be required to show valid evidence of vaccination against typhus, absence of clinical symptoms suggestive of typhus fever, and freedom from lice.

Immunization.--All military personnel should be given a stimulating dose of typhus vaccine if more than three months have elapsed since the primary series or last subsequent stimulating injection. Civilian personnel engaged in any phase of typhus control should be immunized or given the indicated stimulating injection. On the occurrence of one or cases of typhus in camps of displaced persons, refugees, or prisoners of war, vaccination should be practiced to the extent required by local conditions.



Delousing.--Delousing is the core of typhus fever control, the one reliance above all others. The methods and technics for delousing of the person and of clothing and equipment are set forth in detail in the section on Insect Control, Part X of this presentation.

Specific Epidemiologic Procedures.--The attack on foci of typhus fever centers on two general methods - delousing and immunization. The following directions serve as a guide in meeting individual situations.

Civilian Communities.--When one or more cases of typhus fever has occurred in a small civilian community of less than 500 population, delouse every individual and when feasible vaccinate everyone.

When one or more cases of typhus fever is present in towns of more than 500 population, but are localized in one town or one area, the following procedure is recommended; delouse all patients and their known contacts with DDT powder. If patients are admitted to hospital, delouse all hospital personnel and other known contacts in the hospital. Vaccinate all known contacts of the patients, including the hospital personnel. Apply "focal delousing" which is delousing of all persons living in houses adjacent to those in which the typhus patients lived. Place all infected communities off limits to troops.

When several or more scattered cases of typhus have already occurred in a town of more than 500 persons at the time the presence of the disease was first discovered, the program specified above should be intensified by full use of all available facilities, including control teams from other organizations.

Typhus in Military Installations.--Proceed with immunization as already directed. Delouse all personnel. Reimmunize all attendants and those concerned with typhus control who have not received an injection of typhus vaccine within two weeks. Limit pass and leave privileges until fifteen days have elapsed since the last reported case.

Typhus in Camps for Prisoners of War, Refugees and Displaced Persons.--The program of immunization will generally be more extensive than in similar situations in civilian communities of approximately the same size. All immediate contacts should be immunized. It is commonly advisable to immunize all residents of the same barracks or general camp area where a case has occurred. Complete immunization of the entire camp is usually not necessary, but judgement should depend upon local conditions. Delouse all

residents of the camp. Establish quarantine of the camp until fifteen days have elapsed since delousing was completed. The occurrence of a new case within that time requires extension of quarantine until fifteen days from date of last report.

Operation of Case Finding Teams.--Case finding teams are ordinarily the principal reliance in initiating the specific epidemiologic procedures just outlined. Their equipment includes 10% DDT powder, 2 hand dusters, vaccine, syringes and needles, and macroscopic Weil Felix kit.

Depending upon circumstances and the individual judgment of the team, some of the measures listed separately under operations in time of epidemic may be necessary. Routine and continued control measures in respect to general populations, observation of the progress of outbreaks, and further responsibility for medical care of patients are functions of the regularly constituted medical authorities, not of the case finding teams. Their duties include:

Examine and obtain full history of any confirmed or suspicious case of typhus fever whether the patient is actually ill or convalescent. Confirm diagnostic impressions by Weil Felix test of the blood serum of the patient. Check with bedside macroscopic Weil Felix test whenever possible.

When a positive diagnosis is made, the following procedures are carried out: The patient, attendants, and all members of the household are immediately deloused with DDT powder administered by hand dusters. All but the patient will be given an initial 1 cc dose of typhus vaccine. A full history is obtained to determine possible sources of infection (the bite of the infected louse occurred approximately 12 days before onset of fever). Arrangements are to be made for care of the patient in hospital under isolation precautions.

Operation of Insect Control Group.--Delousing operations as determined specifically by the case finding team and in accordance with defined policy and prescribed technic. Assist and organize delousing operations in camps of displaced persons and prisoners of war.

Control Measures - with Typhus Declared Epidemic.--If the admission rate for typhus fever is steadily increasing after two weeks, in spite of the measures initiated above, the advice of a consulting epidemiologist should be requested.

In civilian outbreaks, serious consideration should be given to mass delousing where admission rates are maintained or have increased after two weeks. This decision should ordinarily be taken only after consultation with superior authority.



With typhus fever widely disseminated within an area, consideration should be given to establishment of a cordon sanitaire, to protect uninfected regions. The essentials are an infected region and a clean or relatively uninfected region, with the two separated by a strong natural barrier such as a river or mountain range. A cordon sanitaire based on an ordinary political boundary is difficult to maintain.

Particular attention must be given to protection of international maritime and air traffic at ports and airports.

Case finding facilities must be increased by calling on organized teams of other commands, or by organization of extemporized teams whose training is best accomplished by brief service with regularly constituted teams.

Operation of Case Finding Teams.---In addition to the duties involved in investigation of sporadic or endemic infections, the following are practiced: Interview all doctors and officials (mayor, police chief, high school principals or teachers, priests) of infected areas to learn of possible typhus which is occurring or might have occurred within the previous year.

Visit each hospital, making similar inquiries. All suggestive leads from the history of patients must be investigated in order to uncover other sources of infection in neighboring villages, jails, concentration camps, barracks, air raid shelters, or hospitals. In serious situations, house-to-house canvas should be organized, using all civilian and military help available, in a search for missed or unreported cases.

Full use should be made of the police in organizing mass delousing, in apprehending relatives and friends of patients for immunization, and in delousing. Each medical officer should prepare a written summary of each day's activities, these to be compiled into a weekly report to the area authority by the senior medical officer among the case finders. All new cases will be reported daily to the area health authority.

Operation of Insect Control Groups.---Aid and supplement the activities of case finding teams in newly uncovered foci of infection. Organize mass delousing when ordered by superior authority. Establish control of ports and airports in quarantined countries. Function in the operation of a cordon sanitaire.

Administrative Management of Typhus Control in the European Theater.---Consideration has thus far been given to the likely extent of the typhus problem that would be encountered in Germany, to the decisions that were made in choice of methods and procedures for typhus



control, and to the technical details of the plan that was involved. The established division of authority for executing that plan under conditions existing in the European Theater is now presented, together with a brief statement of the part that various organizations took in the active planning and in the control of typhus in the field.

Areas of Responsibility.--The responsibility for typhus control among troops in the field, among casualties and among prisoners of war was always a continuing responsibility of the Chief Surgeon of the theater through the Division of Preventive Medicine.

The control measures to be applied to civilian populations, including displaced persons, were developed wholly by the G-5 Division, Public Health Section of SHAEF, with correlation and collaboration by the Office of the Chief Surgeon, ETO.

The development of sources of supply for the materials necessary to adequate control was a function of the Office of The Surgeon General, Washington. The importance of research and development, of provision of facilities for manufacture and for assurance that these supplies reached the theater were of prime importance. The distribution of supplies within the theater was brought about through active cooperation on the part of the Medical Supply Division of the Office of the Chief Surgeon and of the Quartermaster Corps with frequent support by G-5 SHAEF, and the United States of America Typhus Commission.

Facilities for adequate medical care of patients with typhus fever were developed through action by the Medical Department for military patients and prisoners of war and by G-5 Civil Affairs for civilians and displaced persons.

Changes in Administrative Authority.--The control of communicable disease among civilians was early designated a responsibility of the Assistant Chief of Staff, G-5, European Theater of Operations. A theater order defining staff duties and responsibilities for Civil Affairs first noted certain executive and administrative duties and functional responsibilities. Specific responsibilities covering Civil Affairs administration in respect to medical services were then defined to include (1) Requisitioning, storage, and bulk issue (complete Allied Relief Branch or Civil Affairs Division units) of medical supplies for civilian use; and (2) Supervision of public health and sanitation, including supervision of rehabilitation of civilian hospitals, and the issue of such regulations regarding the control of sanitation and disease conditions among civilians as are necessary to the proper safeguarding of the health of the military command.

A somewhat earlier ETO Civil Affairs administrative memorandum on Public Health which was never rescinded, stated that the

organization and function of such medical and sanitary activities as may be necessary to the complete development of the Civil Affairs policy were to be provided with the supervision and coordination of the Chief Surgeon. In practice, during the invasion and occupation of France, Luxembourg, and the United States sectors of Belgium and Holland, the control of civilian health problems was an active and inclusive function of G-5, Military Government, Public Health branch.

The policy for delousing civilians as part of the typhus program was stated in G-5 directives as follows: All displaced persons will be deloused immediately upon their arrival at centers prior to repatriation and as often thereafter before arrival at destination as may be considered necessary by competent medical authority. All refugees coming from or going to areas where typhus is endemic or where sporadic cases in a current typhus season have occurred will be deloused if ten percent or more are found to be louse infested, otherwise only those found on inspection will be deloused.

The G-5 plan for typhus control as elaborated at the time American troops entered the endemic area of the Rhineland, provided for delousing of the groups most likely to spread typhus. This included persons with typhus and their immediate contacts; inhabitants of communities on a mass scale if large epidemics occurred and louse indices were high; displaced persons leaving or passing through Germany, Poland, and the Balkan countries; and louse infested refugees and louse infested inmates of concentration camps, jails, or other institutions in areas where typhus occurred or was likely to occur. Immunization of doctors, nurses and related hospital personnel was directed, as well as administrative and operating personnel in displaced persons and refugee centers and jails. Use of flying squads for case finding and control was endorsed.

The program outlined was sound, but from the first discovery of typhus in the Rhineland, it became increasingly evident that active typhus control in the field was beyond the scope of the numbers of Military Government personnel then available. On 4 March 1944 an altered plan of organization for typhus control in respect to continental operations was recommended by the Division of Preventive Medicine in a memorandum to the Chief Surgeon. Consideration was given to four groups of people: troops in the field, casualties returned to the United Kingdom or to the Zone of the Interior, prisoners of war and the civilian populations in operational areas.

Control of typhus in the first three population groups had always been the responsibility of the Medical Department, United States Army. With regard to civilians the following recommendations were made: (1) That the responsibility for immediate control measures among civilians rest with the Chief Surgeon, ETOUSA. (2) That the necessary pool of supplies be authorized and obtained by the Medical Department, United States Army. (3) That joint plans be initiated with the Civil Affairs Division, UNRRA, or other agency,



to the end that responsibility for typhus control in relation to civilian populations be assumed by such organization within a thirty day period.

On 28 March 1945, Supreme Headquarters Allied Expeditionary Forces (SHAEF) issued the following order: "To protect personnel of this command it is necessary that public health function in enemy occupied territory be a responsibility of Command and under the direction of unit medical officers in all echelons." Within a brief period this action was brought about; with medical officers of all echelons responsible for typhus fever within their areas of responsibility, irrespective of its occurrence in civilian or military personnel; and with technical supervision of the program of control by the Chief Surgeon of ETOUSA. Unified and intensified effort led to an increased level of accomplishment.

Conduct of Field Operations.--The Chief Surgeon of the theater carried the responsibility for general direction and execution of the control program. From early March 1945, and soon after typhus became a problem, the Medical Department had primary responsibility. Many echelons, organizations and individuals took part:

The Medical Department.--The Office of the Chief Surgeon, Division of Preventive Medicine (Chief of Division Colonel John E. Gordon) was almost wholly responsible for the entomologic aspects of typhus control principally through the Chief Entomologist, Colonel Emery C. Cushing, and Major Ralph Bunn. General epidemiologic direction was by Major William L. Hawley. Eight case finding teams of the division worked with various armies of the Command, furnishing the solid field help so essential to control. Statistical and epidemiologic analysis of the outbreak, including supervision of reports and reporting, was provided by Captain William S. Brumage and Captain Edna Cree.

The Office of the Surgeon, Twelfth Army Group, Division of Preventive Medicine, Colonel Tom F. Wayne, had the intimate direction of field activities which assured coordination between Armies, and useful and concerted action. Direct supervision of the cordon sanitaire was an additional function.

The innumerable surgeons of armies, corps, and divisions and their staffs were directly concerned with implementing the program. They did the work of the day. To this group more than all others fell the responsibility for the necessary measures upon which satisfactory control depended.

Civil Affairs Division G-5.--The Public Health Section at SHAEF headquarters prepared and issued the technical directions for control of typhus fever among civilians. They assured the provision of adequate supplies.



Through the various echelons of command of G-5, and through constituted health officers and teams, active control in the field was contributed both initially when the responsibility rested in Military Government, and later when Public Health sections joined with the Medical Department to serve under direction of the Surgeons of corresponding echelons.

United States of America Typhus Commission.—The United States of America Typhus Commission provided all supplies of vaccine and gave continuous aid in obtaining other necessary supplies. A consultant (Lt. Col. John Synder, later Major David Greeley) was furnished the Chief Surgeon for active field work during the height of the outbreak. A team of specialists was assigned for study and evaluation of therapeutic measures in one of the major centers of infection. The Field Director of the Commission, Brig. General Leon Fox, gave repeated aid and advice to the Office of the Chief Surgeon, and with the Chief of Preventive Medicine made three comprehensive field surveys during the outbreak.

Field Operations in Typhus Control, ETOUSA.—Active field control of typhus fever as it developed in the European theater fell logically into four well defined phases. These were largely determined by the state of developing military operations and the increasingly close contact with typhus in epidemic proportions as the Armies approached Germany.

Typhus control in the United Kingdom was wholly a matter of training and development of methods.

The opening of the European campaign brought problems in connection with prisoners of war and the possibility of introduction of the disease into Great Britain. This second phase lasted until March 1945. Military progress toward Germany brought the Armies nearer to known centers of infection. It introduced problems connected with refugees and displaced persons, and demanded increased watchfulness to prevent introduction of infection into territory acquired in the progress toward Germany through France. Figure 4.

The first direct contact with typhus was made when the Rhineland was occupied. This third and active phase of field operations gave results that largely determined the ultimate success of typhus control in Germany proper.

The fourth phase was marked by the passing of the Rhine. Here was the real typhus problem; in numbers of cases, extent of distribution, and in the opportunities for overwhelming spread, as Germany milled about in the final chaos preceding the end of the war.



Figure 4

A power duster is used to delouse liberated slave laborers and political prisoners, Munster, Germany, May 1945.





The work of the first two phases was of limited extent and essentially exploratory through giving opportunity for the testing of methods, materials and organization. It is briefly described. That of the two significant stages--typhus control in the Rhineland and in the Inner Reich - is presented in succeeding sections of this presentation.

Typhus control in the United Kingdom.--No typhus control work was necessary in the United Kingdom until after D-Day 1944, when incoming louse infested German prisoners presented the hazard of introducing typhus. The delousing of prisoners of war on the Continent before trans-shipment to Great Britain was not feasible during the early phases of the Normandy campaign and delousing was consequently done on arrival in the United Kingdom. Prisoners under American jurisdiction were processed through a single center, where their clothes, belongings, and persons were thoroughly disinfested by use of methyl bromide, bathing and louse powder.

Typhus Control in France, Belgium and the Netherlands.--Although no authentic cases of typhus occurred in France, Belgium, Luxembourg, or the American sector of Holland from D-day through 1944, certain groups of the civilian population were deloused as a preventive measure. The groups so treated included native refugees returning to their homes as their section of the country was liberated; foreign Todt workers left behind by the retreating Germans; and political prisoners found in local jails.

Prisoner of war labor came into use on rather an extensive scale on the Continent. The prisoners were a heterogeneous lot since they included not only native Germans, but persons of many nationalities who had been impressed into the German military service. Many were heavily louse infested and disinfestation was necessary before farming them out to American units as labor crews. This was the most serious problem in typhus control encountered during military operations of 1944. It was complicated by under-estimation of the number of prisoners that would be captured, and the consequent lack of adequate provision for transportation, quartering, feeding, and medical treatment and supplies.

With the steady and progressive liberation of more areas in Northern France, Belgium, Holland, and Luxembourg, the problem of disinfesting refugees and displaced nationals became greater. In addition, numbers of conscripted laborers began to trickle back from Germany to their home countries. During this period (late summer, autumn, and early winter 1944) the standard plan for handling displaced persons began to function.

Control stations were set up along the border of the liberated countries through which the majority of persons returning from Germany were expected to pass. The stations were equipped with delousing facilities in the form of DDT powder and hand dusters.

Large assembly centers were established in liberated countries, principally in the larger cities where facilities were most readily available. The centers received displaced nationals from Border Control Stations; large groups being sent directly to them under controlled transport as increasing numbers of such persons were uncovered. Delousing facilities were included in the sanitary provisions of the centers.

Typhus in the Rhineland.—The Rhine River constituted a natural boundary within Germany, separating the Rhineland or Westmark, from the main body of the country, the Inner Reich. Advance intelligence had yielded information that while typhus fever was more or less scattered throughout Germany, the Rhineland was relatively free in contrast to other parts of the country, especially the easternmost districts contiguous to the Russian front.

The broad program of typhus control in Western Europe was therefore based on an effort to free the Rhineland of typhus as expeditiously as possible, through intensive application of measures and the use of all possible facilities for case finding, in order that a cordon sanitaire could be set up along the Rhine. The purpose of the cordon sanitaire was to provide and maintain an area close to the front and essentially free of typhus, in order that supply operations and the necessary regrouping and reorganization of troops before assault of the Rhine might be facilitated. It had the further purpose of limiting the penetration of typhus to the liberated countries to the South and East, particularly France and Belgium, and to the British Isles, all of which were important from a military standpoint because they served as bases for supplies and for reserves of troops. Typhus introduced into any of these countries would constitute a hazard to our armies and to operations.

Tactical considerations required that after the advance of American troops through the Rhineland to the river, a time lag would be introduced before assault of the Rhine was undertaken. Need would exist for regrouping, reorganizing and bringing up supplies. Thus from the standpoint of time, and epidemiologically, the differences in the problem of typhus control in the Rhineland and within Germany proper are sufficiently definite to make separate discussion advisable.

Typhus fever was not encountered by the Allied troops until they actually entered Germany. Typhus had been present in France in the winter of 1943-1944. Indeed, the first epidemiologic reports reaching the American Army after the invasion of the Normandy beaches in June 1944, brought word of the existence of typhus fever on the Cotentin peninsula during the Spring of that year, the last case having occurred in May. Conscripted Russian laborers were principally involved although a few cases had occurred among German soldiers. During the remainder of 1944 and the early part of 1945, no typhus



fever was encountered as our troops advanced across France and into Belgium, Luxembourg and Holland.

The first cases of typhus fever in Germany were uncovered on 3 March 1945 after the advance across the Roer River. The patients were Italian laborers who had contracted the disease in a German labor camp near Wassenberg and had arrived by a devious route at an American military hospital in the vicinity of Aachen.

As the Rhine River was approached, an increasing number of persons suffering from typhus were found among conscripted foreign labor groups and in lesser numbers among German civilians, principally medical attendants. The majority were in areas occupied by the Ninth and First Armies, with scattered cases encountered in the Third and Seventh Army sectors. The four armies on the line were deployed in the above order from North to South. A rather severe outbreak was found in Cologne. The only other large center of infection was an area in the vicinity of Munchen-Gladbach.

The Rhineland or Westmark.—The area is bounded on the east by the Rhine River and on the west by the national boundary of Germany which touches in order the Netherlands, Belgium, Luxembourg and France. The Rhineland extends in the north from the junction of the Waal and Rhine Rivers to the French border at the point of intersection of the Rhine Province itself, the Saarland and the Palatinate.

Aachen outbreak.—Typhus was first reported in the Rhineland, not by one of the advance units or hospitals as might have been expected, but by the 10th Medical Laboratory, then assigned to the First Army. Four samples of serum had been received from the Military Government detachment in Aachen with request for examination for antibodies of typhoid and typhus fevers. Agglutination tests were positive in high titer with the antigen of Proteus OX19. Subsequent field investigation by a medical officer of the laboratory revealed that several Italian conscript laborers traveling from Holland to Aachen had fallen into the hands of the Ninth U. S. Army. Four who were ill were transferred to the 91st Evacuation Hospital and in turn to the Maternity Hospital in Aachen. A Military Government medical officer of the First. U. S. Army discovered them, made a tentative diagnosis of typhoid or typhus, transferred them to the hospital for communicable diseases in Aachen, and sent serums to the laboratory for examination. All four patients were convalescent at the time, and the onset of symptoms apparently dated from about 15 February 1945.

Aachen had been heavily bombed. The population had largely left the stricken city, but among those who remained living conditions were such as to present unusual opportunities for spread of typhus. From all available information, Aachen itself had been free from the disease previous to the incident described. Almost no typhus occurred in the city thereafter, despite the



presence in the immediate vicinity of one of the larger camps for displaced persons. Such infections as were noted subsequently were the result of displaced persons entering the area already ill or in the incubationary stage of typhus fever. Nine cases were reported in March, three during April and two in May, a total of fourteen.

Munchen Gladbach Outbreak.—The first cases of typhus fever had scarcely been reported from Aachen when the Ninth Army discovered five patients in the city of Munchen Gladbach. The report was made under date of 5 March. A field investigation was promptly instituted by Ninth Army authorities who were joined the next day by epidemiologists from the Office of the Chief Surgeon. All five cases involved patients or personnel in a principal hospital of the city. Infection apparently arose from a Dutch Todt worker who was admitted to the hospital with a diagnosis of diphtheria and died. Subsequent infections were among immediate contacts.

A rapid survey of the area surrounding Munchen Gladbach demonstrated the outbreak to be of greater import and extent than that encountered in Aachen. Not only was the city involved, but also the labor camps in the immediate vicinity, with typhus apparently disseminated rather broadly throughout the surrounding territory.

Munchen Gladbach was the center of an industrial area. Much forced labor had been brought in to build the fortifications of the West Wall, an estimated 50,000 persons. Typhus was present in seven labor camps, located in most instances near small villages. Energetic case finding turned up 75 patients with typhus fever in various stages of convalescence, of whom 29 appeared to have been infected rather recently. The problem was further complicated by information that in a number of instances patients convalescent from typhus fever had left hospitals when American troops entered the area, and had wandered into various towns and villages.

The best available evidence from German public health authorities, hospitals and labor camps indicated that typhus fever had first appeared in November of 1944, when two Russian Todt workers became ill in Neuss, across the Rhine from Dusseldorf. Subsequently two nurses who had cared for patients developed typhus fever. From Neuss the infection spread to the Munchen Gladbach area, involving various camps housing conscripted laborers. Records were found of 183 cases, dating from the original outbreak in November to the time of the preliminary survey in March and including the 75 patients found by American troops.

The Wassenberg camp was the first installation seriously involved, 20 cases having occurred there in January, with the first patient a Pole who became ill about the middle of January. By 1 February the disease had appeared in other nearby camps and to an extent, in the general region surrounding the camps. Thereafter the situation progressively became more serious, so much so that German authorities

set up a special typhus fever hospital in Johannesthal. Records at the hospital showed 133 patients admitted up to 27 February.

The total 183 cases for the Munchen Gladbach area includes only patients admitted to civilian hospitals. Those treated in camps or dispensaries reportedly represented an appreciable number, of whom several had died. The number of cases cited is probably less than fact.

Russian and Polish laborers were most frequently affected, with some few of Dutch and Italian origin. The 15 native Germans were without exception exposed through contact in caring for patients.

The five principal camps in which typhus appeared were Wassenberg, Schwannenberg, Rheindahlen, Wegberg and Breyel. Although the spread of infection could not be accurately followed, the camps were within a radius of seven miles and workers were known to visit frequently. Conditions were favorable to the transmission of the disease among the 50,000 workers in this west wall area, because from observation and from the statements of patients a great proportion had body lice and living quarters were maintained at a minimal scale.

The concern about the situation evidenced by the Germans was attested by their having sent some twenty of the early patients to Dusseldorf for study. In late January an administrative memorandum had been circulated by German authorities among the local medical profession announcing the presence of the disease in the area. On 9 February the XXI SS Corps issued an order placing Schwannenberg and Rheindahlen off limits to soldiers. These two camps were evacuated in February, personnel being deloused before leaving and those ill being removed to civilian hospitals. Many conscripted laborers were removed across the Rhine at that time.

An active program of control was instituted by the Surgeon of the Ninth Army. Visits were made to some forty cities and villages. No typhus was found in the strictly German population. It became clear that the disease involved principally displaced persons and particularly those living in camps immediately west of Munchen Gladbach. In addition to the seven foci of infection discovered in the original survey area, three others were subsequently determined. The diagnosis of typhus was primarily clinical, supported in some instances by serological tests.

The program of control depended upon two measures, delousing by dusting with DDT powder and vaccination. Persons living in camps where typhus fever had appeared were without exception dusted with insecticide powder and usually redusted at the end of three weeks. Irrespective of whether typhus fever had appeared or not, displaced persons in all camps were disinfested before transfer to their homes or to collecting stations. Particular attention was given to delousing



contacts of patients, including hospital personnel. Vaccination of all staff members concerned with the control of typhus fever was effected, whether they belonged to the U. S. Army, were German personnel, or were displaced persons. In addition intimate contacts were immunized and if infection in a given camp was widespread, all were immunized. These measures served effectively in controlling the outbreak.

From November until early March an estimated 108 cases occurred. The number at the time American troops arrived and up to 15 March, was 75. During the last half of March 74 new patients were recognized of whom 48 were in the city of Neuss and constituted a sharply developing fresh outbreak. During April the number was 15, all from Neuss; and in May the total was three for the area, with two from Neuss.

The outbreak in Neuss had particular interest. The early history of typhus in the region indicated that the disease had been introduced at Neuss. That circumstance led to a prompt visit and the visits were repeated. An interview with the burgermeister and the health officer on 22 March, that being the fifth visit, produced the statement that no typhus existed in the city. Typhus was discovered on 26 March. An officer of the Ninth Army, in search of hospital accommodations, casually observed 21 patients with typhus fever under treatment at the Neuss City Hospital, a bunker hospital with isolation barracks. They had been in the hospital for a number of days under the erroneous diagnosis of paratyphoid fever. The identity of the disease was first determined on 25 March.

An epidemiological investigation on 27 March gave information that on 3 March three displaced persons in the late stages of a febrile illness had been admitted from a local labor camp, Lager-standard. Because of active military operations in and about Neuss, hospital personnel lived in the concrete bunker hospital along with the patients. On 14 March a nurse became ill with fever and died on the 20th after a short severe illness. Other hospital personnel rapidly became ill--two on the 17th, one on the 18th, four on the 19th, three on the 20th, three on the 21st, two on the 22nd, one on the 24th, and one on the 26th. The patients included four sisters, four nurses, seven maids, two male nurses, and a Polish girl who had visited a friend at frequent intervals. All of the patients were isolated in a separate small building but the nurses continued to live in the hospital.

A number of patients in the bunker hospital with war wounds developed fever after 20 March, and others who had been discharged became ill at their homes. The 48 patients included 17 hospital personnel, four daily visitors to the hospital, and three of untraced address. Three died; two sisters and one patient. The diagnosis of paratyphoid was still being made five days after the first death from typhus.



Through discharged patients the infection spread to Holzheim, a nearby community, but was limited to the original patients discharged from the Neuss hospital. A program of prevention gave satisfactory results. A vaccination and delousing clinic was set up for general use of the public. The police aided greatly in search for typhus suspects in six large air raid shelters (bunkers) and the fourteen displaced person centers of Neuss. Full use was made of public health education through nurses and doctors of the city.

Because of its bunker hospital overcrowding and the complete absence of isolation technic, the Neuss outbreak resembled in explosiveness the epidemic of typhus fever in the air raid shelters of Naples in 1944. Its localization tended to make effective the control measures which were undertaken. In all, 65 cases were included in the outbreak. Forty eight were discovered in the last four days of March; in the succeeding month 15 new cases occurred, and in May there were two.

Cologne outbreak.—At almost the precise time that a center of typhus infection was being uncovered in the Munchen Gladbach area, evidence came to light that an epidemic of almost equal importance existed in the First Army area in the region of Cologne.

Promptly after entrance of American troops into that city, a survey was made by medical officers of the Cologne Military Government detachment to determine the possible existence of typhus fever. They found 65 patients with acute or convalescent disease scattered throughout the city, in hospitals, air raid shelters and prisons. Many were former inmates of the Klingelputz Gestapo prison who had been sent to the Augustinerinne hospital; some were displaced persons of foreign origin; and about one-third were native Germans. A general survey of the population indicated that German civilians were not commonly infested with lice, but that displaced persons and prisoners usually were.

Until the end of January 1945 only a few sporadic cases had occurred in the general population of Cologne. Typhus fever had become increasingly frequent in the Klingelputz prison, and that institution served as the principal focus of infection for the city. In early February the disease began to spread generally.

An additional focus of infection developed on 6 February 1945, when some 20 members of the Cologne police force came down with typhus fever. Shortly thereafter, some 25 patients and nurses at Augustinerinne hospital became ill with typhus. The police apparently had acquired their infection in the course of delivering prisoners to the Buchenwald concentration camp and in turn had introduced the disease into the hospital population.

Control measures were promptly directed by American authorities to the Gestapo prison as the most important single source

of infection. Prisoners suffering from typhus fever or suspected of having contracted the disease were removed to hospital. Apparently healthy inmates were deloused by dusting and evacuated to nearby displaced person centers. All were immunized.

Dusting guns and supplies of DDT were distributed to hospitals and air raid bunkers. Through organization of teams of German civilians, largely drawn from health department personnel, more than 5,000 persons were deloused within forty-eight hours. Sufficient insecticide powder was provided to insure disinfection of new patients admitted to hospitals. Displaced persons were rounded up and sent to newly organized displaced person camps on the outskirts of the city. They were dusted with DDT powder before entering the camp.

Within a week persons living in prisons, air raid shelters and hospitals had been deloused. Typhus vaccine was administered to everyone, both military and civilian, who was in close association with typhus fever patients or engaged in delousing operations.

A system of reporting new cases of typhus fever gave particular attention to determining outstanding sources of infection. Spot checks were conducted by examining persons on the street. Louse infestation was found to be at a low level among German civilians and no case of typhus fever was discovered in the course of these observations.

Including patients found by American troops when they entered the city 5 March 1945, 120 cases of typhus fever had occurred in Cologne, all essentially within the previous six weeks. Thirty-five of the patients had died of typhus fever. During the remainder of March, 68 new cases were found. The control measures served virtually to eliminate the disease within the month, for in April only two new cases were reported, and nine occurred in May, to give a total of 199 cases in Cologne up to 1 June 1945.

The results accomplished were remarkable in view of the chaotic conditions then existing in Cologne. Prisoners released from concentration camps were scattered through the population. Large numbers of conscripted laborers were suddenly released to wander where they wished. They were everywhere within the city. They went to nearby villages, to cities as remote as Aachen, and sometimes even into France and Belgium. Nevertheless only four communities in the immediate vicinity of Cologne were actually invaded by typhus and only one seriously so, the village of Hermulheim, a suburb of Cologne five kilometers from the city proper.

Hermulheim Epidemic.—A group of sixteen Ukrainian laborers, both men and women, left Cologne in the early days of the American occupation. They stopped for two days in Hermulheim, population 1,600. During the two nights they remained in the village they slept in an



air raid shelter which cared for the residents of two streets of the town. Hermulheim had previously been free from typhus fever. The Ukrainians went their way, but subsequently two were seen in Aachen with classical typhus fever infection.

During the days immediately preceeding 24 March 1945, 30 German residents of the town developed typhus fever. All had used the air raid bunker in which the Ukrainians had slept. A German physician from the Communicable Disease hospital in Cologne recognized the disease as typhus fever, promptly reported the situation to the Military Government Detachment in Cologne, and sent two wagon loads of patients of 12 each to the Augustinerinne hospital in Cologne. An additional patient was in a local hospital and twenty suspects were under observation.

When Hermulheim was visited that evening, the burgermeister and his health officer had already instituted quarantine. The following morning the entire population of the village was deloused by dusting, and vaccinated. In the course of the following week the number of demonstrated cases increased to 58. No single secondary case occurred after the accepted incubation period. This outbreak and the control measures employed demonstrated clearly the potentialities associated with the introduction of typhus into a susceptible civilian community, and the results to be expected from prompt inauguration of modern control methods.

Moselle and Nahe River Area.--This part of the Rhineland was occupied by the Third U. S. Army. It was much less affected by typhus fever than other parts of the province. A small group of outbreaks involved twelve towns and included 69 patients. The first localized epidemic was not discovered until 23 March 1945, long after the larger outbreaks to the north had come to light. Ten new localities with typhus present were discovered in April and none in May. Eight scattered cases in May occurred in three towns originally recognized in April as being infected.

Palatinate Area.--The first typhus fever in this Seventh U. S. Army area was determined during the early part of April. During the remainder of the month six communities were invaded and the number of cases was eighteen. May saw only one newly invaded town and a total of five cases in the area.

Alsace and Lorraine.--Although not included in the Rhineland, it is worthy of note that typhus did not occur in Alsace and Lorraine, this being territory occupied by the First French Army. Few imported Eastern European foreign workers had been brought into the area by the Germans.

General Course of the Rhineland Epidemic.--In interpreting data on the progress of the epidemic, the number of patients involved and the communities that were invaded, it is essential to understand the sources of reports. The chaotic conditions



in Germany had led to a complete breakdown in the official system for reporting communicable disease.

A method extemporized by United States Military Government detachments in cities was the principal source of information for German civilian populations. This procedure gradually became formalized, but reporting from towns was always much better than from rural districts. Reports of typhus fever in displaced person camps were forwarded through the Displaced Persons branch of Military Government. Many cases were reported through Army sources. The best available data in relation to recognized outbreaks in whatever population they occurred came from the special Typhus Case Finding teams attached to Armies.

It was necessary to have been on the ground to appreciate the difficult conditions under which these data were gathered. Attempt was regularly made to check their reliability through a second source and as far as reported cases go, the numbers are believed to be reasonably accurate. Undoubtedly a goodly number of infections with typhus fever were never recognized as such, and others never came to report.

The first patient with typhus fever was recognized on 3 March 1945, although the illness antedated that time. During the first month of active operations in the Rhineland, March 1945, no less than 23 towns, cities or villages were found invaded by typhus. (Figure 5). In most instances frank typhus fever was present when the community was occupied by American soldiers. The patients commonly represented an accumulation of typhus fever infections over the previous six weeks. Many were convalescent. Others were of recent origin and some developed the disease within an accepted incubation period after the American forces took over. Some few true secondary infections occurred.

A lesser number (8) of invaded communities represented fresh outbreaks of typhus fever that developed after American occupation. These situations arose principally during the latter days of March and represented centers of the disease established by the migration of persons, ill or incubating the infection, from localities where typhus had been epidemic. In two instances, the outbreaks were fairly sizeable, those at Hermulheim and at Neuss. During March records were obtained of 560 patients with typhus fever. In some few instances these referred to old cases, with the patient no longer infectious and discharged from medical care. The great bulk were still in hospital, had developed the disease prior to the arrival of American troops, and were in various stages of convalescence. The available information was insufficient to determine precisely how many patients had developed the disease before arrival of United States troops and how many first presented symptoms thereafter. It is furthermore impossible to know what proportion of new infections developed within an accepted







incubation period and what proportion represented true secondary infections. Nevertheless, an estimate of about 150 new infections within the Rhineland in March after occupation by American forces would be fairly close to fact.

During April the number of localities from which typhus fever was reported was greater by three than for March, the number being 26. It is significant, however, that no further cases developed in April in 19 of the communities from which typhus was reported in March. That only four had further cases in April indicates a most satisfactory performance in control. It is by no means certain that the patients in the four communities continuing to report typhus fever in April were definitely related to the original outbreak. Particularly in the larger cities, persons were continually entering from across the Rhine as well as from other parts of the Rhineland. The apparent continued presence of typhus fever in these instances may very well have resulted from reintroduction of the disease, rather than from secondary infection arising from previously existing cases.

In the Rhineland as a whole, 22 fresh outbreaks were discovered during the month of April. They appear to have developed most often through migration of persons from previously infected communities of the Rhineland, particularly Cologne. Some few outbreaks were known to have arisen from persons in the incubation period of typhus fever who crossed the Rhine and later developed the disease in the Rhineland.

The total number of cases discovered in the Rhineland in April was 91; of which 24 were related to existing centers of infection of the previous month and 67 were associated with newly developing outbreaks.

The month of May in turn showed a distinct improvement over April. The number of communities with typhus fever was only thirteen. Of the 26 localities where typhus had occurred in April, 18 had no cases during May, and eight communities had a limited number of secondary infections, five of them large cities. Only three new centers of infection were recognized. Two of the communities reporting typhus in May had previously had cases in March but none in April. The course of events remained undetermined. It was not possible to ascertain whether the circumstances corresponded to a reintroduction of the disease or a continued chain of infection with an intervening missed case.

Total typhus infections in the Rhineland in May numbered 37. Twenty-six came from foci established in previous months, eleven from newly developing outbreaks. The five cases that occurred in June were all single cases in separate localities, four previously invaded and one new. Information is presented in Table 6

for infected communities, together with the distribution of cases during the four months of the epidemic.

The number of recognized cases of typhus fever was 693. About 400 were present when American troops entered the region, and represented the accumulation from February. The number of new cases in March was about 150 which decreased to 91 in April, 37 in May and 5 in June. The end of March found the possibility of further extension virtually eliminated. No more than a reasonable endemic level characterized the month of April, and the first of June found the region practically free from the disease. (Figure 6).

Typhus Fever by Population Groups.--No camps of Allied prisoners of war were found in the Rhineland. Prisoners previously held there by the Germans had been evacuated across the Rhine. This group consequently does not enter into a consideration of typhus in the Rhineland.

Among the many German prisoners of war captured in the Rhineland only three contracted typhus fever during the period March to May. Recently captured prisoners were usually found free of lice; they were maintained so by repeated dusting with DDT powder. Relatively few had been vaccinated in the course of their military service, and they were not vaccinated when taken. Their freedom from typhus suggests the greater relative importance in typhus control of assuring freedom from lice as compared with specific immunization. In general prisoners lived under no better conditions than the displaced persons. Figure 7.

The native German civilian population suffered far less from typhus infection than did the group of displaced persons. The population of the Rhineland, including the Saarland and Palatinate, was about fifteen times the estimated population of displaced persons in the region, a number placed at about 500,000. Nevertheless only about one-third of total infections were estimated to have occurred among the native population.

About two-thirds of the cases, some 400, were among displaced persons. Louse infestation was far more frequent than in the native population. Living quarters were more crowded and less provision existed for adequate sanitation and cleanliness.

During the Rhineland experience only two American soldiers developed typhus fever. Both were physicians engaged in typhus control. In one instance the prescribed reimmunization had not been practiced. Fourteen months had elapsed between the last immunization and the appearance of the disease. The infection was mild. The second patient was so mildly ill that recognition of the disease as typhus fever almost escaped attention. He had been vaccinated within three weeks of becoming ill, was never sufficiently

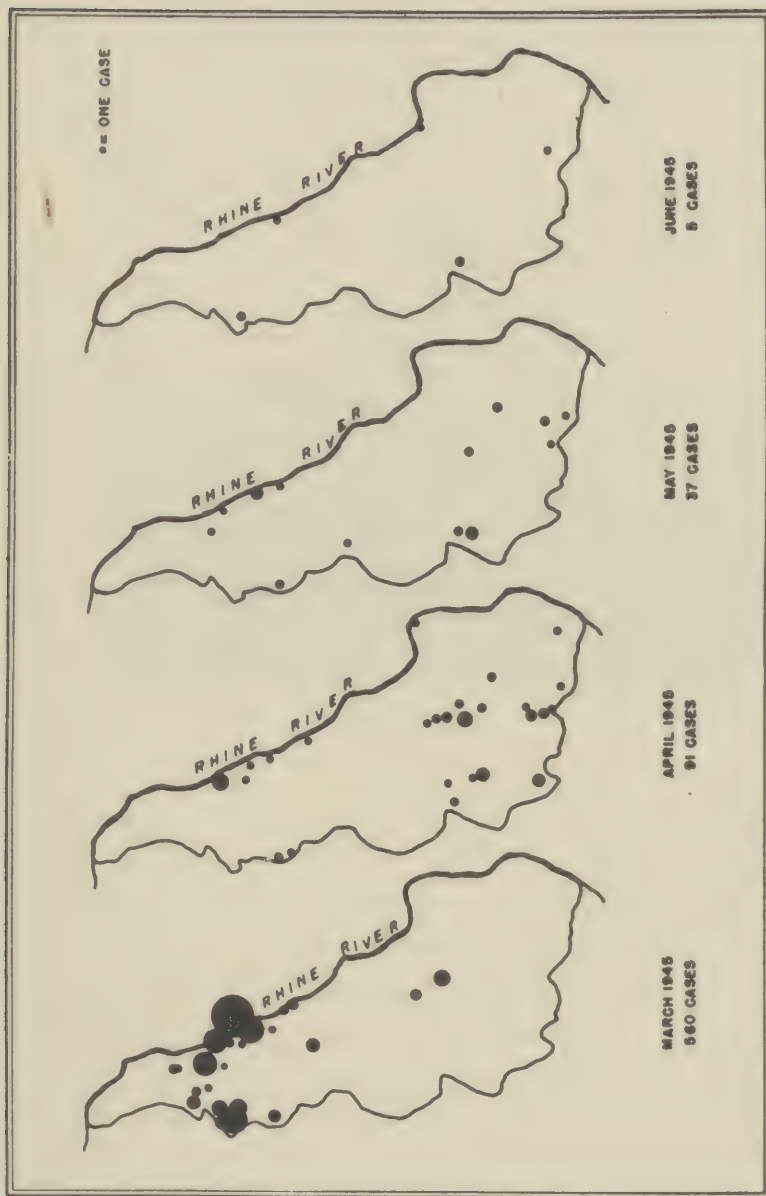


Figure 6

Progression of typhus fever in the Rhineland, cases and localities, March to June 1945.







Figure 7

Delousing in a prisoner of war enclosure is performed by Nazi prisoners, Stenay, France, March 1945.





indisposed to enter hospital and spent only three days in quarters. Lack of prompt recovery led to the suspicion of typhus and the Weil Felix test was found strongly positive.

Case Fatality.--Accurate records on the number of deaths among 693 patients were not obtainable. Information was available for 388 patients, of whom 61 were known to have died, a case fatality rate of 16 percent. Striking differences were observed between the case fatality of native Germans and that of displaced persons, largely of eastern European origin. Twenty one of a group of 60 German patients died, to give a case fatality of 35 percent. Only 5 deaths occurred among 143 patients from the displaced persons group, a case fatality of 3 percent.

Summary.--Within the Rhine Province proper and the contiguous German territory west of the Rhine, the Saarland and the Palatinate, about 400 cases of epidemic louse borne typhus fever occurred in the months immediately preceding the entrance of U. S. Forces, or within the first few days of occupation. The region from North to South was heavily seeded with infection. The potentialities for spread were great.

The whole area seethed with foreign people, conscripted laborers moving this way and that and in all directions, hoping to reach their homes, in search of food, seeking shelter. Most of the typhus was within this group and they carried the disease with them. They moved along highways and in country lanes--now a dozen Roumanians pulling a cart loaded with their remaining belongings; here a little band of Frenchmen working their way toward France, then some Netherlanders, or perhaps Belgians; and everywhere, the varied nationalities of the East, Ukrainians, Poles, Czechs, Russians. They moved mostly on foot, halted, then gathered in great camps of sometimes 15,000 or more, extemporized, of primitive sanitation, crowded, and with all too little sense of order or cleanliness.

These were the people with typhus, the carriers of the virus, the fuel for epidemics; more than a half million of them in the Rhineland, wearied with the war, undernourished, poorly clothed and long inured to sanitary underprivilege and low level hygiene. Add to this shifting population the hundreds of released political prisoners, often heavily infested with typhus but happily far fewer in numbers; the German refugees, first moving ahead of our troops and then sifting back to their homes through the American lines. Rarely if ever has a situation existed so conducive to the spread of typhus. Figure 8.

Typhus fever in a stable population is bad enough. It has demonstrated its potentialities in both war and peace. The Rhineland in those days of March 1945 could scarcely be believed by those who saw it--it is beyond the appreciation of those who did

not. Here were the Four Horseman riding abreast, on the move, with the third well in the lead. It was Wild West, the hordes of Genghis Khan, Klondike gold rush and Napoleon's retreat from Moscow all rolled up into one. Such was the typhus problem in the Rhineland.

Recovering from the Battle of the Bulge at Bastogne, the American troops moved forward and towards the Rhineland on 23 February 1945. The first typhus was discovered in Aachen on 3 March 1945. In quick succession two major centers of infection came to light, one of them spread over a considerable area.

At no time thereafter did typhus fever increase in numbers, despite rapidly deteriorating sanitary conditions and factors conducive to its spread. The end of March saw the situation safely under control. April had almost no cases in comparison with March--one sixteenth the number--while May ended with 29 cases reported for the month and the disease essentially absent. Only two localized epidemics of any size occurred after American occupation, one in Hermulheim and the other in Neuss. Both were toward the end of March, about two weeks after the country was overrun, and they resulted from the widespread and rapid dispersal of typhus infested persons. As sharply developing and extensive as these outbreaks were, one was curbed without a single secondary case. The other was limited to the first wave of cases, a few scattered secondary infections, and the third wave consisted of no more than one case.

A number of factors contributed to this favorable result. The newly developed methods of typhus control proved their worth, wherein reliance was placed on delousing by dusting with DDT powder and on specific immunization with typhus vaccine. The conclusions arising from the previous single test to which these procedures have been put in the Naples outbreak of 1944, were here justified, extended and confirmed.

The time of the year when the Rhineland situation presented was of itself a favoring circumstance. Had the timing of military operations in the Rhineland been a feature of December rather than of March, the typhus problem would have been far greater and perhaps much more serious. It might well have occurred at that time, except for von Rundstedt and his Ardennes counter offensive.

Finally, the careful planning which had carried through all echelons, led to an informed medical department more than adequately supplied with all the things it needed, and ready for prompt action.

From both a military and an epidemiological standpoint, the prompt limitation of typhus in the Rhineland was of far reaching significance. Militarily it permitted unhampered preparation for the assault on the Rhine and the final campaign within German proper. There was no loss of manpower, since only two American





Figure 8

A Polish woman is dusted with DDT powder at a displaced person's camp at Heidelberg, Germany, June 1945.





soldiers contracted the disease, both physicians closely engaged in typhus control. The armies were free of the need to provide medical care for large numbers of civilians ill with the disease.

Epidemiologically, a large territory was provided essentially free of typhus and fronted by a strong natural barrier upon which to base a cordon sanitaire. This also was significantly important. The inner Reich was known to be more heavily seeded with typhus than the Rhineland. The conditions favoring the spread of the disease would be even more pronounced in the final debacle of Germany. The two great advantages arising from such a cordon sanitaire were first, that it would aid greatly in limiting the extension of typhus into neighboring states and into Great Britain, where supply bases were located. Secondly, it made possible a safe and close base for military and typhus fever control operations within the Reich itself.

The practical working of a cordon sanitaire depends upon the presence of a strong natural boundary separating a clean from a contaminated area. These conditions were now provided. The clean area existed, the boundary was stronger than ever by reason of the blown bridges.

The necessary orders were issued establishing a cordon sanitaire along the east bank of the Rhine, to go into effect progressively as territory was acquired. Travel other than military had from the beginning been prohibited at our single Remagen bridgehead, as much for military and security reasons as from epidemiologic considerations. The number of ports of entry was limited. Provision was made for universal delousing of all persons other than military before the cordon was passed, whether by foot, by vehicle or by air.

The more serious problem of typhus in the Inner Reich was now faced with greater assurance.

Typhus in the Inner Reich.--The Remagen bridgehead came into American hands on 7 March 1945. As it gradually expanded through addition of territory the existing opinion that typhus would be a serious problem became more and more justified. Typhus was found in a great many of the cities, towns and villages along the east bank of the Rhine, in Dusseldorf, Mulheim, Remagen and Duisberg; sometimes a few cases only, sometimes as many as sixty. Rumors, informal reports and sometimes just plain conjecture brought word of 300 patients with typhus in Seigburg, just ahead of the First Army; and of the conditions in the great concentration camps at Buchenwald, Dachau and Belsen.

The great assault of the Rhine got under way on 24 March, the British 21st Army Group and the U. S. Ninth Army to the north,

the First and Third Armies in the center, and somewhat later the U. S. Seventh Army and the First French Army to the South. All found typhus fever; the British scarcely any, the Ninth some, the First and Third a great deal, while in the south the U. S. Seventh and the First French Armies again encountered relatively little.

The first really serious situation arrived when Buchenwald concentration camp was occupied by the Third Army on April 12th. The British soon uncovered Belsen camp, with still more typhus and misery. Then followed in order Dachau, Flossenbergl and finally Mauthausen, all with hundreds of cases of typhus fever and sometimes thousands.

These concentration camps with their political prisoners and their typhus fever would have been problem enough. Added to the situation were millions of conscripted laborers suddenly released from employment and from camps that were many times typhus infested. They scattered throughout the country. They were gathered in large improvised camps. They spread typhus widely.

German prisoners of war increased by thousands. Changing policy held them in Germany and the huge aggregations in temporary camps and enclosures gave fertile opportunity for the breeding of typhus. Thousands of native German civilians had evacuated their homes in the early stages of operation and proceeded to Inner Germany ahead of their retreating troops. The end of the war was complicated by their return.

Finally came the release of many thousands of German prisoners of war to return to their homes, -- agricultural workers, certain trade specialists and the older men of the Wehrmacht. Germany in the spring months of April and May was an astounding sight, a mixture of humanity travelling this way and that, homeless, often hungry and carrying typhus with them.

Succeeding parts of this discussion will deal in turn with the progression of the epidemic through the weeks of the Spring of 1945; the outbreaks in the more important centers, particularly the concentration camps; the extent to which typhus was imported into neighboring countries; and finally the incidence of typhus in the United States Army itself.

Geographical Limits of the Inner Reich.--For the purpose of this analysis the Inner Reich will be understood to include that part of Germany east of the Rhine and north of Switzerland which fell under the influence of the United States Army. It included not only a major part of Germany but the westernmost part of Czechoslovakia, the Sudetenland, and the greater part of Austria. Figures 9, 10 and 11 illustrate the area concerned.





Figure 9.

Typhus fever in the Inner Reich, cases and localities, during week ending 20 April 1945.





Figure 10.

Typhus fever in the Inner Reich, cases and localities, during week ending 1 June 1945.











Limited information will be presented on typhus in the British zone of influence, based on reports from the Twenty-First Army Group, but the data presented on numbers of cases and the description of control measures refer only to activities in the American zone. Typhus in Russian held areas is likewise excluded from consideration.

General Course of the Epidemic in the Inner Reich.--The typhus epidemic in the Inner Reich in the Spring of 1945 was no orderly developing process, with a sharp increase to epidemic proportions and a progressive but more slowly ordered decline. The cases reported in a given week represented not so much the progression of the disease as the progression of the armies. The more territory that was uncovered, the greater was the number of reported cases, for Western Germany in the area of the American advance was rather uniformly seeded with typhus. To be sure, there were heavily involved communities and others lightly affected. There were great accumulations of cases in the concentration and prison camps, and in nearby small communities. New cases occurred during the time covered by this analysis, which is 24 March to 29 June 1945. Sometimes they reached considerable numbers, but the great fluctuations from week to week corresponded much more to the discovery of the disease than to its actual occurrence.

Reporting of typhus fever during the advance through inner Germany proper was even more disorganized and irregular than it had been in the Rhineland. In the beginning no attempt was made to separate cases that developed during the period of report from those convalescent or actually closed. A new community would be uncovered, with typhus promptly discovered. The patients ordinarily included those acutely ill, those convalescing, and some who had recently recovered. Actual records of onset were commonly lacking and about all that could be done was to count noses.

Eventually a certain separation became possible for patients in newly uncovered localities, as to whether they represented active infections--to include both acute and convalescent cases--or whether they were cases of record which had been closed at the time the area was occupied. The number of new cases reported from so-called old localities,--those recognized as foci of infection in previous weeks--was likewise inexact. Many were not newly developing infections at all, much less secondary infections, but newly discovered infections existing prior to occupation and not coming to light until days and sometimes weeks later, as an orderly sorting of the sick from the well became possible in concentration camps. The experience at Dachau is illustrative and is described in a later section.

Not until late May and early June, not until the last great concentration camp came under American control, did weekly reports of typhus give indication of the true course of the epidemic--and that course was one of satisfactory and progressive improvement. The first week in June showed far fewer cases than the last two weeks of May, 427 compared with weekly numbers of 1961 and 1502. The end of June saw the number of newly reported cases from all localities, old and new, reach a level of 75. Table 7 gives four kinds of information by weeks from 24 March 1945 to 29 June 1945 inclusive.

The number of cases of typhus reported from localities not previously known to harbor the disease is divided according to active cases found at the time of investigation; and cases of record, the patients having recovered or died. The number of newly reported cases--not necessarily newly developing cases--that occurred in old recognized typhus infected communities is presented in Column 4 of the table. Total cases represents cases by week of report, irrespective of date of onset. Finally the number of communities known to be typhus infected during a given week was subdivided according to whether typhus was recognized for the first time that week or had existed in the community previously.

For the week ending 24 March 1945, typhus was reported from only one locality, the town of Koenigswinter in the Remagen bridge-head. The eleven patients were all foreign forced laborers. (Table 7.) No typhus was recognized during the week ending 31 March. In the week of 7 April, 42 cases were reported from eight newly captured localities. The succeeding week 71 came from nine other places, 52 of them from the Buchenwald concentration camp, which was the first large infected camp to be uncovered by American forces.

During the week of 21 April twelve new cases were reported from two localities which had previously had typhus. In addition, the number of newly recognized cases was markedly increased by discovery of 873 cases in 25 new localities. The majority (777) were from the large prison camp at Siegburg.

For the week ending 28 April 337 cases were found in 29 new places, while 7 old localities reported 25 new cases. Two large epidemics were included, the prisoner of war camp at Nurnburg accounting for 134 patients (all Russians) while Guderselben in the Nordhausen area had 45.

The numbers continued to be great in the week ending 4 May; 848 typhus patients were discovered in 52 newly conquered communities. Two hundred were in the hospital of the labor camp at Flossenbourg, and 337 in the camp hospital at Dachau. Typhus was reported from more new places (52) during this week than in any other week of the epidemic period; and an additional 178 new cases occurred in 13 old localities.



For the next week, that of 11 May, 451 cases were discovered in 41 new localities, of which 246 were in the Mauthausen concentration camp. The number of new cases reported from 20 old foci of infection was 1175, of which 822 were from Dachau alone, and represented not so much newly developing as newly recognized cases.

During the three weeks ending respectively 18 May, 25 May and 1 June, many more active cases were discovered in new localities. This was largely the result of the work of case finding teams, which with the cessation of hostilities and a return of the area to more settled conditions were able to survey the region with care, going into new areas and discovering new foci which had been missed during the rapid advance of the armies. The majority of the new cases found in old localities during this time were from the Dachau camp, where many patients with illness of undetermined nature were ultimately recognized as infected with typhus fever.

The month of June showed a progressive and well marked improvement, to such an extent that only 75 cases were reported for the last week of that month. The number of secondary cases was almost negligible, considering the size of the epidemic in the preceding month. The disease was quickly snuffed out in the newly infected communities where it was found. The epidemic was at an end.

Scattered cases were recognized in July, 64 in all; and a few in August, 32. Subsequent events showed that typhus in Germany had been brought under complete control, for during the winter of 1945-1946 no more than a reasonable endemic incidence prevailed.

The epidemic of typhus fever within American occupied territory included 16506 patients. The outbreak within the Inner Reich accounted for 15810 of that number. Typhus was recognized in 518 localities of the Inner Reich and about 11,000 active cases in an acute or convalescent stage of the disease were observed during the three months of the epidemic.

Special Epidemiological Problems.--The more important of the outbreaks in camps and prisons are now presented in some detail. Collectively, they constituted the great bulk of typhus infection in Germany.

Dachau concentration camp.--The Dachau camp, located in Bavaria about 5 kilometers north of Munich, was one of the largest and certainly one of the most notorious of the Nazi installations housing political prisoners. It was liberated by units of the U. S. Seventh Army on 1 May 1945. (Figure 12).



An estimated 35,000 to 40,000 prisoners were found in the camp, living under conditions unusually bad even for a German camp of this kind and probably worse than any other that came into American hands. Extreme filthiness, louse infestation and overcrowding prevailed throughout the camp buildings. Several carloads of human bodies were found packed in box cars in the railroad yards adjacent to the camp, the vestiges of a shipment of prisoners from camps farther north who were transferred to Dachau in the late days of the war to escape the advancing United States troops. (Figure 13).

The number of patients in the camps with typhus fever at the time it was first occupied will never be known. Days passed before a census of patients could be accomplished. Several hundreds were found in the prison hospital, but their number was small compared with the patients who continued to live with their comrades in the camp barracks, bedridden and unattended, lying in bunks four tiers high with two and sometimes three men to a narrow shelf-like bed; the sick and the well; crowded beyond all description; reeking with filth and neglect - and everywhere the smell of death.

During the first few days little more could be done with the limited staff that was available than make the rounds of the barracks, pulling out the dead and the dying. Although some hundreds of patients were in the camp hospital with typhus fever on 1 May when the camp was first taken, large numbers died and many were added before the first census of patients was made on 3 May. At that time the hospital population was 297.

In the course of the next week this number was increased by 822. For the week ending 18 May, 1,263 additional cases were recognized, and the greatest number (1,343) came during the week ending 25 May. For the week of 1 June 1945, 277 new infections came to record and as of 1 June 1945, 1,580 patients were under treatment in the several hospitals associated with the camp. The daily distribution of cases is presented in Figure 14.

The record is not by day of onset but sets forth the number of patients recognized on a given day as having clinical symptoms of typhus or being in the convalescent stage of that disease. In many instances the onset was days before, and not uncommonly weeks. This was particularly true of cases recorded in the second and third week of the experience.

The records of the first week include two principal groups, patients found in barracks so severely ill with acute and apparent typhus as to be transferred to hospital, and a lesser number reporting ill for the first time and sent to the camp dispensary with early typhus. Thereafter, a thorough search was



Figure 12

Bodies found in a crematory room when Dachau Concentration Camp was liberated by the Seventh Army. Many had died of typhus. May 1945.







Figure 13

Box cars filled with bodies of prisoners who died en route to Dachau were found at Seeshaupt, Germany by the Seventh Army, May 1945.



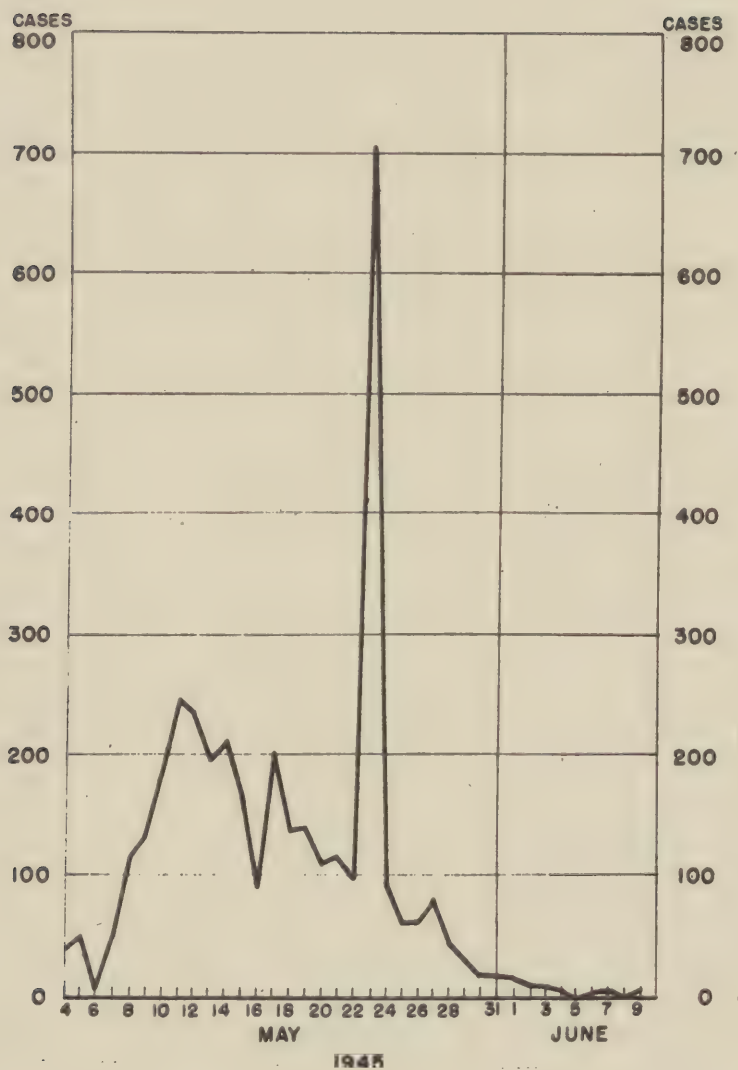


Figure 14

Typhus fever admissions, Dachau Concentration Camp, Germany, 4 May to 9 June 1945.





made barrack by barrack for all patients with typhus. As a result, reported cases increased strikingly. The experience of 23 May is illustrative. After a number of days when the number of newly recognized cases ranged from 100 to 150, there was a sudden rise to 700. On this particular day a group of some 600 patients previously under observation in the inner camp hospital and carried as typhus suspects were officially notified as typhus fever.

Available records failed to demonstrate how many of the 4,032 patients of the Dachau epidemic were actually ill with typhus at the time the camp came under American jurisdiction, how many developed the disease within the succeeding 14 day incubation period, and how many represented true secondary infections after American responsibility came into play. The relatively small numbers reported in the last days of May, and the essential disappearance of the disease in June would suggest that secondary infections were held to a very satisfactory level. Certainly the majority were either ill at the time the camp was taken over or were within the incubationary stage of the disease.

Even the appreciable figures cited fail to include all who contracted typhus fever in Dachau concentration camp. Freed from the sort of existence they had been living, it was no wonder that those strong enough should attempt to escape. Many of the prisoners did so, and scattered widely through the nearby country, especially to the region south of Munich. Some were actually in the clinical stages of typhus fever and many were incubating the disease. They were later found with typhus fever in other areas. The epidemiologic significance of such movements of prisoners and displaced persons will be discussed subsequently.

An energetic program of control was instituted at Dachau by the Surgeon of the Seventh U. S. Army. The camp was promptly quarantined. Hospitals were moved in to augment the small prison hospital in the care of patients. A consultant of the United States of America Typhus Fever Commission spent ten days at the camp. Case finding teams from the Office of the Chief Surgeon aided in the early control work through survey of the surrounding area for former inmates developing typhus after leaving.

The dusting of prisoners with DDT powder was started 3 May 1945 and completed 8 May. Three officers and six enlisted men equipped with two power dusters, twenty hand dusters and three hundred pounds of powder were made available for the work. One power duster was set up in a central position within the prison compounds, and all ambulatory prisoners were passed through this dusting station. The other power duster, supplemented by hand dusters, was used in the prison hospital and in blocks of barracks to assure that all patients with typhus were freed of lice. Prisoners, supervised by Army personnel, quickly mastered the technic

and were used liberally in dusting operations. In the course of the five day period, 36,045 persons were dusted and 2,500 pounds of DDT powder was used. A dusting station, operated by prison labor and supervised by an enlisted man, was set up at the gate of the compound and no one - visitor, physician or attendant - was allowed to leave the enclosure without first being dusted.

Immunization of prisoners against typhus fever was put into force as soon as conditions permitted. The primary emphasis was on delousing. In respect to case fatality, data are available for 2,336 cases reported up to 1 June. The number of patients who died was 311, and the case fatality rate was 8.3.

Of all the centers of infection encountered in this generalized outbreak in Germany, Dachau was easily the most extensive; and because of the deplorable conditions under which control measures were instituted, it was easily the most difficult to control and the most serious in its epidemiologic portent.

Typhus in the Nordhausen Area. This part of Central Germany near Leipzig was captured by the First U. S. Army in mid April 1945. The region contained several forced labor camps, two of which had typhus patients at the time they were captured by American troops.

Fifty one (51) patients were in the Gudersleben camp which housed 560 workers. They had received excellent attention from two Russian doctors and a staff of Russian nurses who were among the prisoners. No deaths occurred and by 2 May, 18 had been discharged from the hospital. The entire camp personnel was dusted with DDT powder on 17 April. Nine new cases were reported 2 May. It is probable that some were incubating the disease at the time they were disinfested.

Five other confirmed cases of typhus in the Nordhausen area were discovered in the hospital at Camp Dora where they were being treated for typhoid fever by a German civilian doctor. Four (4) were conscript laborers and the fifth was a nurse at the hospital. Inmates of the camp and the staff of the hospital were deloused and as of the end of May, no further cases had been reported.

Typhus in Siegburg Prison.--The Siegburg Prison was on the east bank of the Rhine near Bonn, Germany. It was liberated by elements of the First. U. S. Army on 20 April 1945. Living quarters in the camp were bad and most of the prisoners were infested with lice. A hot bed of typhus was present, with no less than 777 patients with the disease. More than 1,000 cases were said to have occurred since January 1945, with about 290 deaths.

Control measures were immediately put into force by Army personnel augmented by prison help. Isolation of patients, dusting of the entire prison personnel and vaccination of the hospital workers



were the measures used. Twenty-five (25) new cases appeared as of 4 May 1945 and eleven between that time and 18 May. Precise information as to the numbers that occurred from 18 May to 1 June is lacking, except for the statement that the disease rapidly disappeared.

Typhus at Buchenwald Concentration Camp.---Buchenwald camp was located in Central Germany near Weimar and was liberated by troops of the Third U. S. Army on 10 April 1945. It had long had the reputation of one of the most notorious of the German concentration camps. About 25,000 men from almost every country in Europe were housed at the camp.

Fifty two patients with typhus were isolated in a separate ward of the camp hospital at the time the camp was occupied. They were of various ages and their nationalities were as follows:

21	Polish
13	Russians
6	Germans
3	French
1	Czechoslovakian
1	Belgian
1	Hungarian
1	Lithuanian

According to the German medical officer at the concentration camp, typhus had occurred in epidemic proportions twice during the past winter with some several hundred cases in all. The present hospital population was the residue from those epidemics. Typhus in Buchenwald was said to have originated from patients brought into the camp from other prisons in Germany. The insanitary and crowded living quarters naturally contributed to the spread of the disease among the permanent residents. The case fatality rate at Buchenwald was 25 percent and measurably higher among western Europeans than for Russians and Poles.

The first members of the medical department of the Third U. S. Army who entered the camp started an intensive typhus control program which was continued by the First U. S. Army when it took over. Figure 15. Twenty dusting teams were organized and the entire personnel of the camp was deloused with DDT powder. Living quarters were thoroughly cleaned, and clothing and bedding were disinfested by steam or gas. The hospital staff of about 150 doctors and attendants were immunized against typhus.

Typhus at Flossenbergl Concentration Camp.---Located near Weiden, Germany on the Czechoslovakian border, the camp formerly housed 15,000 conscript laborers employed at the assembly center of a Messerschmidt aircraft factory. It was liberated by the

Third Army late in April 1945. The camp population included Poles, Roumanians, Czechs, Yugoslavs, French and Bulgarians, in about that order of numerical importance. Just prior to the allied occupation the Germans had evacuated all except 1,600 workers, leaving behind only the sick, the injured and the non-transportables. The prisoners were started on a march to Dachau. The original column of about 14,000 reached Cham, some 80 kilometers away, with a strength of only, 6,000. Some became ill and died along the way, a number presumably of typhus fever. The majority scattered along the route of the march, with the result that typhus subsequently broke out in a large number of small communities. The area gave rise to one of the most serious epidemiologic problems anywhere in Germany. Figure 16.

Typhus had not occurred in Flossenbergl until September 1944, when a number of workers sent from the Cologne area became ill shortly after arrival. By 15 October, 82 cases of typhus were determined on clinical evidence, with 26 having a Weil Felix agglutinin titer at serum dilutions of 1/1200 or more. A diagnosis of typhus was not permitted by the Schutz Staffel doctor in command, and isolation of the patients was not practiced. The accepted diagnosis was of grippe but physicians continued to submit requests for Weil Felix examinations. With a change of SS supervisors in February 1945, the diagnosis of typhus was permitted and patients with the disease were transferred to a single ward block staffed with immune personnel.

The height of the epidemic came in February. Beginning about the first of that month, a general movement of workers from camp to camp within Germany came into common practice with frequent exchanges of prisoners between Dachau, Buchenwald and other camps including Flossenbergl. This undoubtedly served to enhance transmission of typhus generally. The incidence and mortality in the various population groups of the Flossenbergl camp during the period 14 February to 1 May 1945 is shown in Figure 17.

At the time of the American occupation, 200 patients were in the prison hospital with typhus, most of them convalescent and properly isolated in separate wards. Typhus control measures had been undertaken by the Germans before the arrival of American troops, and new cases were at a minimum. The measures that had been employed were disinfection of clothing, block isolation of patients, camp quarantine and the use of immune medical personnel to care for patients. Additional measures initiated by the United States Army included the selective administration of typhus vaccine and the delousing of all inmates and attendants.

Since the greater part of the camp population had been removed and many of those remaining had already had typhus, the control of the disease was comparatively simple. Only 69 typhus





Figure 15

Two dying prisoners lie among hundreds of dead on a barracks floor. Concentration camp at Wiemar, Germany, May 1945.







Figure 16

Flossenberg Concentration Camp was liberated by the  
97th Infantry Division, Germany, May 1945.





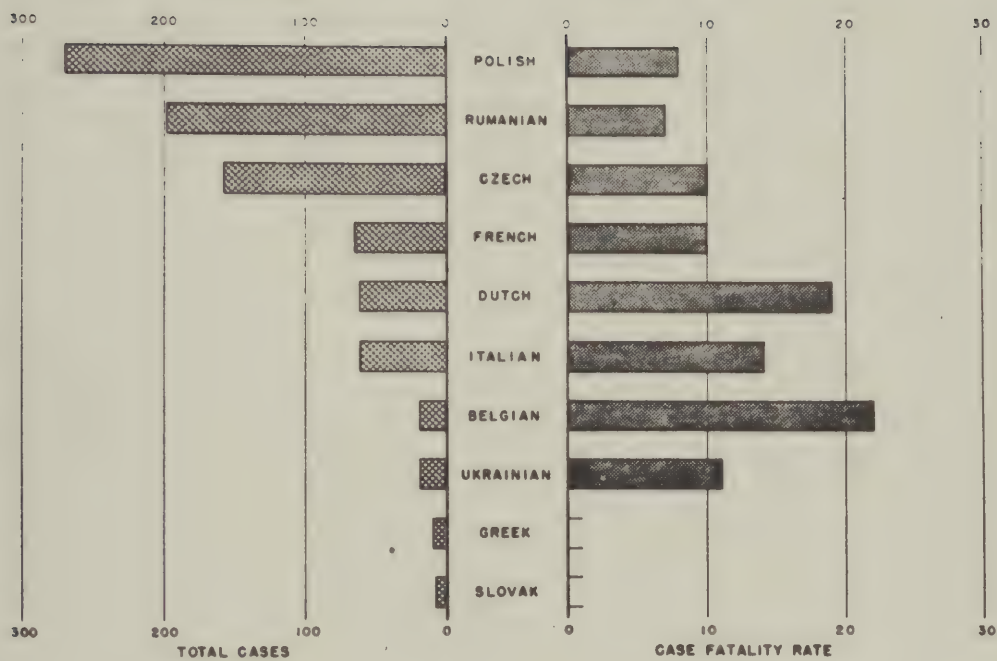


Figure 17.

Typhus fever, Flossenberg Concentration Camp, cases and deaths, by nationality, 14 February to 1 May 1945.



fever patients were under treatment at the hospital on 14 May, of whom 36 were convalescent. By the 1st of June only a handful remained.

Typhus in the Mauthausen Camp. The Mauthausen concentration camp was liberated by units of the Third U. S. Army on 5 May 1945. Because of early reports of great numbers of patients with typhus, the Third Army Typhus Case Finding team followed close on the forward elements who took the installation, and indeed arrived shortly after it was overrun.

Mauthausen, with two smaller adjacent camps, was located on the north bank of the Danube River near Linz, Austria. The total population of the three camps was approximately 28,000, of whom 3,000 were Jewish women from many countries of Europe. Living quarters were crowded and unsanitary, and louse infestation was unusually prevalent throughout the camp areas. Figure 18.

A case finding study revealed 246 definite cases of typhus and 30 others with fever and suspected of typhus; 134 were males and 112 were females. The exceedingly high rate for females was the result of unusually crowded living quarters, and failure to isolate women with typhus although the men had been segregated in a fashion in a corner of the camp hospital. The majority of the patients were Russians, Poles and Czechs.

Epidemiological enquiry showed that during the previous winter as many as 600 cases of typhus had been present in the camp at one time, the disease having originally been introduced by a Russian prisoner of war in 1942. Since that time typhus had been present in epidemic proportions every winter.

Typhus continued to be a problem in this camp for the next month. The control program was effective in reducing the incidence of the disease, but new infection was repeatedly introduced by displaced persons and it was evident that a number had escaped the initial delousing, because frankly secondary cases occurred. Nevertheless, on 1 June 1945 only 70 patients remained in the hospital.

Typhus in the Liberated Countries. Typhus fever began to be reported with increasing frequency in the liberated countries of Western Europe during April. Nearly all of the infections were related to repatriated persons who had returned to their homes from labor and prison camps in Germany. Despite the number of potential sources of infection that were set up in France, Belgium and the Netherlands, only a few confirmed secondary cases were reported. The season of the year was a favoring circumstance and the louse population in the countries to which they returned was low. From



political and patriotic motives, prisoners were often returned in violation of the required quarantine period, and in too many instances before they were properly deloused. (Figure 19)

Typhus fever was reported in France to the number of 276 cases as of 30 June 1945. Table 8. Denmark had 15 cases, Belgium 136 and 49 occurred in Holland, all in countries previously free from the disease. The number in June was nearly half that for May because of the general subsidence of the epidemic.

When by accident or by force of politics, some relatively few unprocessed individuals were introduced into the country of origin, typhus promptly followed; a circumstance which demonstrates the material protection afforded the other countries of Europe by the cordon sanitaire, the mass delousing and the other control measures which were put into effect in Germany.

Typhus Among German Prisoners of War.--The first confirmed typhus fever to appear among German prisoners of war was in March 1945. A large proportion of recently taken prisoners were found infested with lice, and very few had been vaccinated against typhus fever. Theoretically the conditions favored sizeable outbreaks, but because of the strict control under which prisoners were held, preventive measures were more than usually effective. The following brief account of typhus fever in a prisoner of war enclosure is in illustrations:

EPIDEMIOLOGIC CASE REPORT NO. 1. Two confirmed cases of typhus were reported in two different prisoner of war enclosures in the Remagen area early in April. The enclosures housed many thousands of prisoners. One alone had 183,000 and the crowded conditions were decidedly conducive to the spread of typhus. By application of strict quarantine, isolation of patients and mass delousing a major outbreak was averted. In fact no confirmed secondary case occurred in either camp.

A total of 90 recognized infections of typhus fever was reported among German prisoners of war during the three months under consideration; three in March, 21 in April, and 66 in May. The increasing numbers of prisoners that were taken as the war drew to a close, and did not represent an increase in rates. No frank outbreak of typhus fever occurred in any of the prisoner or war camps.

Typhus Among Recovered Allied Military Personnel (RAMP)--Only two confirmed cases of typhus occurred among recovered American prisoners of war. Brief case histories follow:

EPIDEMIOLOGIC CASE REPORT NO. 2. A major of the Medical Corps was captured 20 December 1944 and imprisoned in Stalag 12A Limburg, Germany on 2 January 1945. He served as physician to the prison



Figure 18

An infirmary at a Nazi concentration camp, Linz, Austria,  
May 1945.







Figure 19

Liberated French and Belgians wait for transportation to a displaced persons camp. Delousing is required before crossing the Rhine River (the Cordon Sanitaire). Cologne, Germany, April 1945.



infirmary until 1 April 1945 when he was liberated. He was well until 13 April when he was admitted to the 61st General Hospital with fever, an eruption of the skin and malaise. The clinical reaction was typical of mild typhus, and on 21 April that diagnosis was confirmed by a positive Weil Felix test in serum dilution of 1/1280. In all probability this officer contracted the disease while a prisoner in Stalag 12A where typhus was present. The last typhus vaccination was in August, 1944.

EPIDEMIOLOGIC CASE REPORT NO. 3. An American enlisted man, held prisoner of war for some weeks, had been moved from one prison to another as the Germans tried to evade the advancing allied Armies. He stated that he was infested with lice most of the time. The patient became ill on 12 April with a low grade fever and a feeling of general malaise, but a rash of the body was not seen. The diagnosis of mild typhus fever was confirmed by a positive Weil Felix test in serum dilution of 1/320.

Typhus occurred most commonly among Russian recovered prisoners of war and only in this group to an extent approaching truly epidemic proportions. When the large allied Prisoner of War camp at Nurnberg was uncovered in April, nearly all of the more than 300 patients with typhus were Russians. Russian prisoners of war recovered by American troops during the three month period April to June, included 382 with typhus.

Typhus was not very common among the British and French prisoners of war who came into American hands; 15 British and 3 French as of the first of June.

Typhus in the Russian Occupied Areas of Germany.--Knowledge of the extent to which typhus occurred in the Russian occupied area of Germany remained meager. No information was obtained from Russian liaison officers concerning those parts of Eastern Germany, Austria, and Czechoslovakia which came under Russian influence. Rumor had it that there were many thousands of cases. Certainly the refugees entering the American area from Eastern Germany frequently brought typhus with them. The disease had apparently been introduced into Germany originally in the early years of the war from Poland and Russia. Medical intelligence which generally proved very reliable had indicated that eastern Germany was more heavily infected than the western and southern parts of the country. It is thus logical to assume that there was even more typhus in the Russian area of occupied Germany than in the American Zone, although factual proof is lacking.

Typhus in British Occupied Germany.--British responsibility was related to that part of Germany to the North and West. Formal reports of the typhus situation in that area are lacking but the



conditions were always fairly well known through personal visit of American Typhus control officers to 21st Army Group Headquarters and through exchange of information with the representative of the U. S. A. Typhus Commission who was attached to that organization.

The total number of cases and the number of infected localities were much less than in the American Zone. The major outbreak centered about the large concentration camp at Belsen an epidemic which ranked in size and importance with that at Dachau. The number of patients with typhus fever approached three thousand. Other than Belsen, the cities and towns with typhus fever were said to number about ten and cases were few.

Typhus in U. S. Military Forces.--Only three confirmed cases of typhus occurred among U. S. troops serving in the European theater. Two infections were contracted in the Rhineland and one within the Inner Reich. All three patients had mild attacks of the disease, as indicated by the case histories.

EPIDEMIOLOGIC CASE REPORT NO. 4. A captain of the Medical Corps investigated a typhus outbreak at Fischbach Germany on 23 March 1945. He was intimately exposed to the disease while examining and disinfecting patients but does not recall ever having found lice on his person. On 9 April he developed a macular rash. He was never delirious, stuporous or disoriented. His convalescence was rapid and uneventful. A Weil Felix test on 17 April was positive in a serum dilution of 1/640. The patient had not received a stimulating dose of typhus vaccine since the original course in April 1944.

EPIDEMIOLOGIC CASE REPORT NO. 5. A lieutenant colonel, Medical Corps, accompanied the officer noted in Case Report No. 4 and both became ill on the same day. The illness in this instance was even less severe. The patient observed no rash at any time. He remained on quarters status during his illness and returned to duty 15 April. A stimulating dose of typhus vaccine had been administered on 23 March 1945, the day previous to his exposure to the disease. The stimulation antedating that was in September 1944.

EPIDEMIOLOGIC CASE REPORT NO. 6. A sergeant of the 15th Infantry became ill 4 April 1945 complaining of pains in the legs, headache and fever of 102°. He was admitted to hospital and observed for several days. On 22 April he was transferred to a general hospital with the diagnosis still undetermined. The patient had daily chills with fever up to 104° for 11 days and at one time developed a slight rash on the wrists, ankles, and abdomen. A Weil Felix test performed 5 May was positive in dilution of 1/320. No likely source of infection could be determined and there was clinical difference of opinion as to the identity of the disease.

It is to be noted that 21 cases of typhus are contained in the Statistical Health Reports. A number are known to concern prisoners of war and not American soldiers. The cases cited include all verified instances of typhus infection among American soldiers in Europe.

Control Measures.--The general overall plan for the control of typhus in Germany has been discussed. It is pertinent however to review briefly just how the plan unfolded and how it was put into effect in the control of typhus in the Inner Reich.

The first consideration was to find promptly the many victims of typhus. Notwithstanding the rapid advance of the armies, a reasonably accurate account of typhus in each of the army areas was maintained, and reports were received without great delay. The forward divisional medical units of armies were on the alert to report typhus wherever it was encountered - in hospitals, prisoner of war camps, labor camps and prisons.

Case Finding Teams.--The reports of existing disease were investigated by the special Typhus Case Finding teams attached to armies. Eight such teams were furnished by the Office of the Chief Surgeon and the service was augmented by special teams organized by the Armies themselves. Each corps had at least one team. The Case Finding teams not only kept the Army Surgeon, and in turn the Chief Surgeon, informed about the incidence of typhus and the general regions where it was occurring, but they initiated typhus control measures of an immediate and urgent nature, subsequently turning over to the regularly constituted medical authorities of the unit occupying the area the responsibility of further and routine measures. Their primary function was that of medical scout.

Insect Control Teams.--The most important single measure for the control of typhus was the delousing of typhus patients and contacts with DDT powder as soon as practicable. This was done by numerous specially constituted delousing teams equipped with both hand and power dusting equipment. The teams were made up of medical department personnel of detachments, battalions and regiments. They frequently made use of civilians who worked under their supervision. In large scale operations the delousing teams of Quartermaster Corps troops from Fumigation and Bath Units were of distinct aid. Several thousand persons were often deloused in a single day.

Immunization.--Another important control measure was the immunization of the immediate contacts of patients with Cox type typhus vaccine, a measure also employed routinely for medical personnel and hospital attendants of patients. In some instances entire populations of infected camps and other centers of infection were immunized.



Care of Patients.--Medical care for typhus patients originating from the civilian and displaced persons groups was provided in German civilian hospitals. The prison hospitals of concentration camps were in large part staffed by doctors of the camps themselves. U. S. medical installations were sometimes used in emergencies.

As the epidemic developed in Germany and Austria, the cardinal principles of the control program remained unchanged, but specific applications became better defined and standardized. Modifications to fit specific circumstances were added, all of which are incorporated in the general scheme already discussed.

Cordon Sanitaire.--The surprise establishment of the first bridgehead across the Rhine at Remagen on 7 March 1945 required immediate action to prevent the spread of typhus westward from the inner Reich. Initially, a verbal agreement was effected with the First Army that civilians would be prohibited from crossing, pending establishment of formal control by publication of the order for a cordon sanitaire. Similar agreements were made on 20 March with the Third and Ninth Armies. For all practical purposes a cordon sanitaire was now functioning, although it lacked official sanction by higher headquarters.

A conference in Paris on 26 March attended by the field director of the U. S. A. Typhus Commission and representatives of the Chief Surgeon, ETO, of the Surgeon 12th Army Group and from G-5, SHAEF approved the principle of establishing a cordon sanitaire and all agreed to support the informal arrangement pending an official order.

The original plan for a cordon sanitaire prepared in 1943, served as the basis for a SHAEF directive of 31 March 1945 establishing a Sanitary Border extending from a point at the French-Swiss-German border, along the east side of the Rhine River to the Waal River, and thence along the north side of the Waal to the North Sea. All civilians and all liberated prisoners of war leaving Germany were to be deloused with DDT powder before crossing the boundary.

The SHAEF order was followed 12 April 1945, by an order of the European Theater of Operations providing for specific ports of entry for passage from east to west to apply to all civilians and liberated prisoners of war. Guard stations were established at intermediate points to prevent illicit crossing. Transportation of passengers by river or canal boats was suspended. The French government agreed on 11 April to establish a cordon along the Swiss and Italian borders and to institute measures for the control of displaced persons arriving at seaports and by air.

Delousing stations at ports of entry were located near bridges, usually in a displaced persons center. Military Police permitted civilians to cross only if their identification papers had the



necessary endorsement showing recent disinfection. Delousing stations were maintained at entraining points for civilians moving across the Rhine, by rail, and similar provision existed for air travel. Figure 20.

The 820th Quartermaster Fumigation and Bath Company was assigned the task of operating stations of the cordon sanitaire. Power dusters proved of great value but mechanical difficulties and breakdowns were frequent unless operated by trained personnel. As of early April, the First Army was operating a port of entry at Oberkassel, the Third Army at Wiesbaden, the Seventh Army at Mannheim, and the Ninth at Wesel.

Summary.--The validity of intelligence reports on the frequency of typhus fever within the Inner Reich, east of the Rhine, was promptly demonstrated as American troops pushed into Germany. About twenty large centers of infection were uncovered within the American zone of influence, usually related to the principal concentration camps for political prisoners. Several hundred smaller areas with typhus were scattered throughout the country, commonly aggregated about the concentration camps.

A goodly number of localized outbreaks was discovered in March. A flood of cases came to light in April and in early May, as operations extended well into German territory. The full impact of modern control measures became evident in May. June saw the situation established within definitely safe limits, and by July Western Europe returned to a state of low grade typhus endemicity.

Conditions in Western Europe in many respects favored a much greater spread of typhus fever than actually occurred. Germany was in chaos. The destruction of whole cities and the path left by advancing armies produced a disruption of living conditions contributing to the spread of the disease. Sanitation was low grade, public utilities were seriously disrupted, food supply and food distribution were poor, housing was inadequate and lack of order and discipline was rampant. Still more important, a shifting of populations was occurring such as few countries and few times have experienced.

Native Germans, dislodged from their homes and often moving long distances to escape the enemy, were finding their way back home. Millions of foreign peoples imported as conscript labor were milling about the country, often aimlessly, sometimes seeking their way back to their native lands. The roads, the countryside, were full of released German prisoners of war who lacked transportation and were finding their way to their homes on foot. There was the minor group of released allied prisoners of war, not a very important factor in the spread of typhus within Germany, because they were promptly evacuated in an orderly manner, but potentially capable of transmitting typhus to their native countries.

Two decidedly important factors served to limit the extent of the outbreak. The most significant was the time of the year that allied troops entered Germany. Had this been in December instead of March, as would have happened except for disrupted military plans, the problem would have been infinitely more serious. Von Rundstedt's Battle of the Bulge, although of serious import militarily, had the favorable aspect of postponing contact with typhus until the Spring months.

Spring brought a lower potential of louse infestation, it permitted life outdoors instead of crowding within existing habitations, and the movement of displaced persons and refugees was facilitated with consequent greater dispersal. Dispersal of course, has advantages and disadvantages. It tends to disseminate infection broadly -- it limits concentrated outbreaks.

Early repatriation of all Russian nationals, both prisoners of war and conscripted labor, was undertaken in May and completed in June. A large part of available American transport was turned to this end, with the result that thousands of Russians were repatriated each day. They were the population groups with the heaviest incidence of typhus.

Under any interpretation of governing circumstances, much credit must be given to the efficiency of recently developed methods of typhus control, and to the cooperative effort of army agencies which assured they were executed satisfactorily. The value of delousing through dusting with DDT, and the usefulness of typhus vaccine were tried and tested on a scale greater than ever before and under conditions epidemiologically more conducive to extensive and continued spread of the disease. The results attained in the Naples epidemic were confirmed and extended.

The pre-epidemic planning was the result of integrated action by at least four agencies, the Office of the Chief Surgeon, ETO, the G-5 Public Health Section of SHAEF and its lower echelons, the Office of the Surgeon of 12th Army Group and the United States of America Typhus Commission.

Cooperation continued as the problem developed in the field. A general division of responsibility gave the Medical Department, through the Chief Surgeon and the principal operating agency for the armies, the 12th Army Group, the obligation for typhus control among troops, prisoners of war, and returned allied military personnel. Military Government assumed the control of typhus among German civilians and foreign displaced persons. The latter was the major effort. When typhus control for civilians and displaced persons surpassed the facilities of Military Government, all echelons of the Army Medical Department and all of the agencies named joined in a common attack on the problem with the full resources of each.





Figure 20

Displaced persons enroute from Borna, Germany to their homes in France. May 1945.





No single factor contributed more to the satisfactory end of the outbreak than that never in the course of the epidemic were the fundamental supplies of DDT powder and vaccine lacking. The foresight which led to the development of manufacturing facilities in the United States, the accumulation of stock piles in the United Kingdom and the adequate distribution to major commands on the continent was largely the contribution of the staff of the Office of the Surgeon General, Preventive Medicine Service, and of the United States of America Typhus Commission. Naturally, occasional difficulties arose in local distribution, but the supply system was such and the stock piles so great that they were promptly remedied.

The middle of July saw a satisfactory situation in respect to typhus in Western Europe. A slight reservoir of infection continued to exist within Germany; one of decidedly more serious portent in European Russia and Eastern Europe generally. There was need for active concern during the winter of 1945 - 1946.

Recommendation of Future Control Measures.--A number of recommendations were made by the Chief Surgeon of the European Theater as of 15 July 1945. Personnel of the United States Army remaining with the Army of Occupation or associated with it were to be revaccinated as of 1 October 1945. This date, somewhat earlier than might otherwise be followed, was believed desirable because of the relatively long interval since troops of the ETO were last vaccinated, December 1944, and because of the potentialities for recrudescence of the epidemic.

It was recommended that all German or other prisoners of war held by the United States Army as of 15 September 1945 should be immunized or given a stimulating dose if primary immunization had been practiced since capture. They are largely unimmunized either by the U. S. Army or by the Wehrmacht. All displaced persons still remaining in the American Zone should be similarly treated as of 1 September 1945. This staggering of dates obviated overloading existing medical facilities.

The cordon sanitaire appeared to have served its purpose and recommendation was made that it be discontinued as of August.

Particular attention should necessarily be devoted in the winter of 1945 - 1946 toward assuring a low level of louse infestation, especially in the displaced person and prisoner of war groups, and also in the German civilian population. Troops of the U. S. Army could be expected to remain essentially free of lice as they did during the course of operations. Freedom from lice was to be assured through periodic surveys of the groups mentioned; with energetic application of delousing by dusting where indicated.

It was finally recommended that a typhus control expert be continued on the staff of both Eastern and Western Districts of the

American Zone, for case finding, to provide diagnostic service and to advise on control measures. The Eastern District, because it was in continuity with a long existing endemic focus of typhus was to be considered the point of greatest concern.



Table 1

Geographical Distribution of Typhus Fever  
in Germany 1941

Districts	Cases
Eastern Prussia	193
Frankfort-on-Oder	87
Koslin	50
Schneidemuhl	35
Berlin	32
Stettin	29
Austria	19
Danzig	14
Leipzig	12
Breslau	13
Potsdam	10
Dresden	7
Sudetenland	2

Source: The United Nations Relief and  
Rehabilitation Administration of  
Communicable Diseases and Medical  
Notes, Volume II, Number 3,  
7 February 1945.

Table 2

Geographical Distribution of Typhus Fever  
in Germany 1942

Districts	Cases
Prussia	1017
Bavaria	170
Saxony	64
Wurtembury	75
Baden	21
Hamburg	111
Thuringiz	27
Hesse	22
Mecklenburg	22
Brunswich	16
Bremen	6
Anhalt	13
Lippe	1
Saarland	5
Oldenburg	2
Austria	120
Sudetenland	25

Source: The United Nations Relief and Rehabilitation Administration Bulletin of Communicable Diseases and Medical Notes, Volume I, Number 4, 26 July 1944.

Table 3

Geographical Distribution of Typhus Fever  
in Germany 1943

Districts	Cases
Prussia	1238
Bavaria	126
Saxony	72
Wurtembury	26
Baden	5
Hamburg	20
Thuringiz	6
Hesse	20
Hecklenburg	133
Brunswich	83
Anhalt	36
Lippe	2
Saarland	16
Oldenburg	2
Westmark	22
Austria	49
Sudetenland	16

Source: Medical Intelligence Summary #3,  
Office of the Chief Surgeon,  
European Theater of Operations,  
U.S. Army, 9 February 1944.



Table 4

Typhus Fever in Germany and Annexed Territory  
by years  
January 1939 to June 1945 inclusive.

Year	Cases
1939	8
1940	516
1941	2351
1942	2742
1943	5058
1944	No official record
1945*	16506

\* U.S. Occupied Zone.

Sources: 1939 - Health Section of the Secretariat  
of the League of Nations, Weekly  
Epidemiological Record, 26 April  
1945.

1940 - 1943 - The United Nations Relief  
and Rehabilitation Administration  
Bulletin of Communicable Diseases  
and Medical Notes, Volume I, No. 4,  
26 July 1944.

1945 - Division of Preventive Medicine,  
European Theater of Operations,  
U. S. Army.

Table 5

Typhus Fever in Germany

Elements of Population Affected and Mortality Rates 1942 - 1943

Population Elements	No. of Cases	Percentage of Total	No. of Deaths	Mortality Rate
Non Germans	2,069	88.9	95	4.6
Unclassified	172	7.4	22	12.8
Germans	86	3.7	17	19.7
Totals	2,327	100	134	5.71

Source: The United Nations Relief and Rehabilitation Administration Bulletin of Communicable Diseases and Medical Notes, Volume II, Number 3, 7 February 1945.

Table 6

Typhus Fever in the Rhineland

Cases by months and localities  
March to June 1945, inclusive

	March	April	May	June	Total
Aachen	9	3	2		14
Arloff	13				13
Bachenau		4			4
Bad Godesburg	4				4
Bad Kreuznach	5				5
Baumholder		12	2		14
Bergzabern		1			1
Beuren		1			1
Bonn	10		2		12
Brand		1			1
Brauweiler		2			2
Breyel	13				13
Cologne	188	2	9		199
Fischbach		6			6
Gusenburg		1			1
Hermulheim	58				58
Homburg		1	1		2
Johannesthal	3				3
Koblenz				1	1
Kaiserslautern		2	4		6
Kronenburg			7		7
Krefeld	6				6
Kusel		2			2
Lebach		8		1	9
Mainz		1			1
Marmagen			1		1
Meisenheim	19	4			23
Merten	1				1
M. Gladbach	30		1		31
Neuhaus		9			9
Neuss	48	15	2		65
Otzenhausen		6			6
Raumbach		2			2
Remagen		1			1
Rheydt	17				17
Rheindahlen	20				20
Rockenhausen		2			2
Rondorf	12				12
Saarbrücken		1	1	1	3
Schwanenburg	30				30



Table 6 (Cont'd)

**Typhus Fever in the Rhineland**

Cases by months and localities  
March to June 1945, inclusive

	March	April	May	June	Total
St. Wendel		1			1
Suchteln	6				6
Sulzbach			3		3
Trier		2	2		4
Viersen	2				2
Voehem	1				1
Wegburg	10				10
Wesseling		1		1	2
Wassenburg	55			1	56
Total	560	91	37	5	693

Source: Division of Preventive Medicine, Office of the Chief Surgeon,  
European Theater of Operations, U. S. Army.

Table 1

**Typhus Fever in the Inner Reich**

Cases by week of report and origin,  
24 March to 29 June 1945, inclusive.

Week ending	Active cases	New Localities Cases of Record	Old Localities New Cases	Total cases	New	Old	Total
24 March	11	-	-	11	1	-	1
7 April	42	-	-	42	8	-	8
14 April	71	2400	-	2471	9	-	9
21 April	873	296	12	1181	25	2	27
28 April	337	-	25	368	29	7	36
4 May	848	775	178	1801	52	13	65
11 May	451	1326	1175	2952	41	20	61
18 May	714	3	1775	2492	50	40	90
25 May	312	-	1649	1961	32	34	66
1 June	320	21	1161	1502	26	38	64
8 June	17	-	410	427	7	25	32
15 June	4	-	447	451	3	27	30
22 June	7	-	75	82	2	11	13
29 June	24	-	51	75	7	9	16
Total	4031	4821	6958	15810	292	226	518

Source: Division of Preventive Medicine, Office of the Chief Surgeon,  
European Theater of Operations, U. S. Army.

Table 8

Typhus Fever in Allied Countries

Number of cases reported March to June 1945, inclusive.

Country	March	April	May	June	Total
England			10	11	21
France	8		141	127	276
Belgium		3	64	69	136
Denmark		1	10	4	15
Netherlands		1	11	37	49
Scotland			1		1
Total	8	5	237	248	498

Source: Health Section of the Secretariat of the League of Nations, 13 December 1945.





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A HISTORY OF PREVENTIVE MEDICINE  
IN THE  
EUROPEAN THEATER OF OPERATIONS  
UNITED STATES ARMY  
1941 - 1945

PART III - Epidemiology  
Section 5 - Arthropod Borne Diseases  
Number 2 - Malaria and Others

by

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## PART III

### EPIDEMIOLOGY

#### Section 5 - Arthropod Borne Diseases

#### Number 2 - Malaria and Others

Malaria.---The United Kingdom is not a malarious area. Indigenous malarial infections were known to have occurred in some parts of England before 1900, more especially in the south and east, but by the early part of the present century indigenous malaria was apparently either absent entirely or a very rare disease.

Localized epidemics occurred during and after World War I. They were initiated by the return of infected soldiers from abroad into areas where the conditions were suitable for transmission of the disease. During the years 1917 and 1918 a number of cases of malaria occurred in various parts of England among children and adults who had never left the country. In the latter year they became so numerous in some localities that malaria was made a notifiable disease.

There are only four species of anopheline mosquitoes indigenous to Great Britain and only one could be considered a dangerous vector of malaria, *Anopheles labranchiae* variety *atroparvus*, a member of the *maculipennis* complex. It is especially dangerous because the adults habitually live in close association with men, either in dwellings or in animal houses. The species breeds in the United Kingdom almost exclusively in brackish water which occurs primarily in the coastal areas. It spends the winter in a semi-active condition in the adult stage, resting in dark poorly ventilated farm buildings and houses. It may take an occasional blood meal during the winter. Breeding is resumed in spring and the first generation of adults usually appears in late May.

In localities where more than five cases of indigenous malaria occurred in any one year since 1917 *atroparvus* was always present in the houses in large numbers. In districts further inland where only one or two indigenous cases of malaria occurred, it was never possible to determine whether they were infected by *atroparvus* or by the related *messeae*; but it was believed that the variety *atroparvus* was responsible and the reason why the disease did not spread was because this sub-species was not sufficiently numerous in the locality.

Because this species was present in small or large numbers throughout the country there was always a danger that fresh cases of malaria might occur if an infected person came into such an area and was exposed to their bites. Fortunately it was only during the summer



months that temperature conditions were such as to allow the completion of the parasitic cycle in the mosquito; and this takes about 15 to 20 days in England.

The conditions of favorable temperature and humidity occurred most commonly along the southern and southeastern parts of England, usually on the coast and this was where locally contracted cases of malaria had been most commonly recorded. In many other parts of England, although the mosquito was present and human carriers had been introduced, the disease rarely spread until warm weather had continued for some time, combined with a high relative humidity of over 60 per cent. In such areas if malaria occurred, it was usually only as isolated cases.

The distribution of indigenous malaria after the 1914-1918 war was about the same as it was for the recorded prevalence of malaria during the 18th century. It is illustrated in Figure 1. The problem of transmission of malaria by mosquitoes is seldom serious in Great Britain and most measures against mosquitoes are usually undertaken to reduce their numbers to a level at which they no longer cause a nuisance by their bites.

The three factors involved in the spread of malaria all existed in the United Kingdom in 1942. Two of these, a susceptible population and a suitable mosquito vector, were not new. The third, the malarial parasite in the blood stream of patients, was provided in increasing abundance with the hospitalization of malarial patients of the American forces returning from Africa, and from the various armed services of Great Britain as they returned from overseas. Precautionary steps were necessary to prevent the spread of this disease. The matter was of particular importance to American military authorities because most of the United States troops were stationed in the areas most involved, in eastern and southern England.

The Ministry of Health of Great Britain was careful in guarding against the reintroduction of malaria by their home coming troops during the recent war. There was a small flurry of excitement when it was realized that a fair amount of mosquito breeding was taking place in the bomb craters of London and in several of the other southern districts. Only the harmless *Culex pipiens* was found in the craters and the mosquito found breeding in the Underground was *Culex molestus*.

Incidence of Malaria in Great Britain.--During the nineteenth century malaria was prevalent to a limited extent in England and Wales particularly in the southern region, along the eastern seacoast from Hull to Hastings, along the Thames and the Ouse, and in areas above Portsmouth, Liverpool and Bristol.

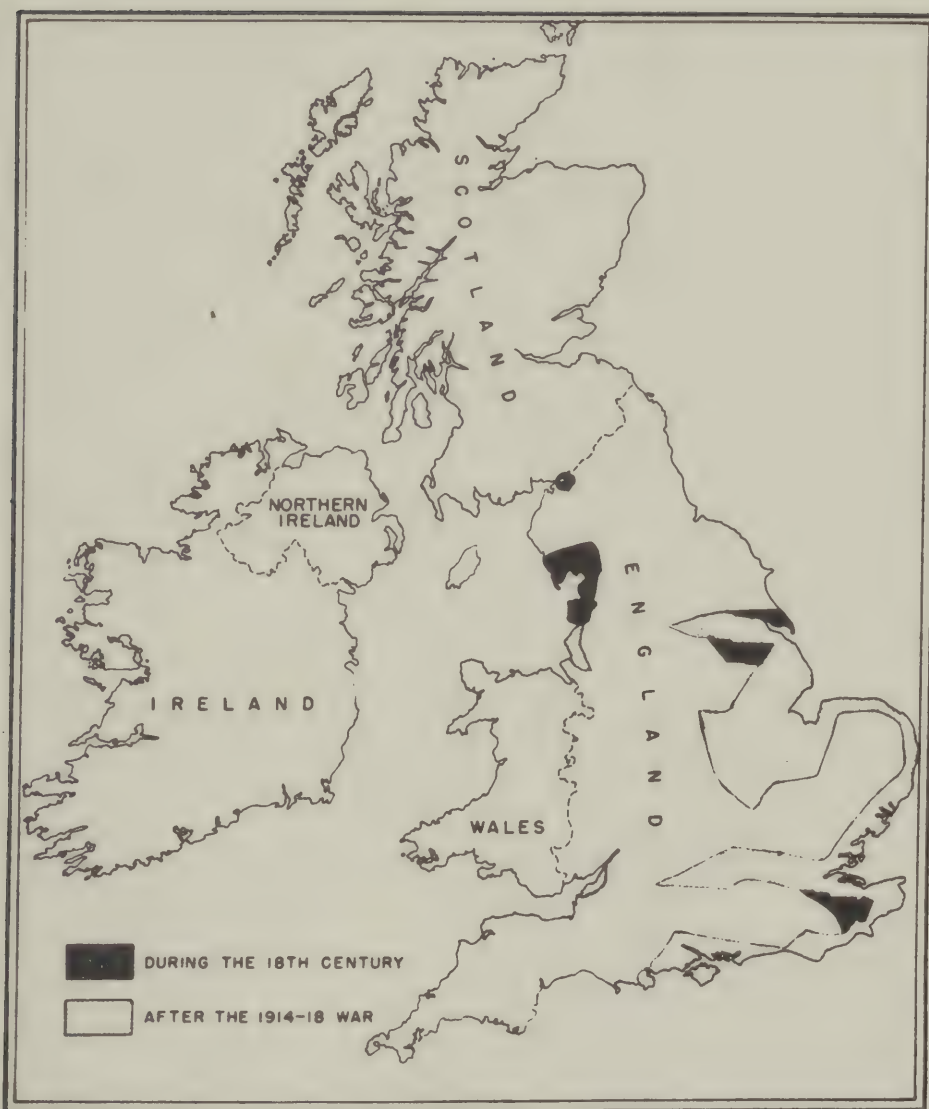


Figure 1

Distribution of indigenous malaria in Great Britain, during the 18th century and after the 1914-18 war.





Deaths from malaria from the year 1910 through 1916 ranged from 50 to 60 each year. In 1917 the number increased to 126; for 1918, it was 197 and in 1919 the number reached 268. While most deaths before the war represented individuals who had contracted the disease in the colonies and had returned to England for reasons of health, a goodly percentage were cases of indigenous malaria which was smouldering in certain coastal districts. The most noteworthy of these was the area comprising Cheerness, Queensborough and the Isle of Sheppey. Indigenous cases also occurred on the Isle of Grain and in the Hoc rural district.

The rise in the number of deaths for the years 1917-1919 was largely due to the return of infected troops from the Middle East. A rise in the incidence of indigenous malaria was likewise associated with these returning troops, of sufficient proportions to warrant the term outbreak applied by the Ministry of Health. This situation was soon brought under control by the efforts of special malaria officers in the areas most involved, but a few cases of indigenous malaria continued to be reported yearly. For the eleven years from 1933 to 1943, the number was 27, with the largest number in any one year being six in 1934. In recent years only two to four infections were contracted in England or Wales in any one year.

Malaria in the United States Army in Britain.---Available records give no evidence of indigenous malarial infection ever having occurred among United States troops stationed in Great Britain during the course of the war just passed. The cases that were recorded were in all instances due to an original infection acquired outside the territorial limits of the United Kingdom.

The majority were recurrent attacks with well established history of previous malaria, though a number were representative of primary clinical manifestations after previous use of suppressive atabrine management. It is to be noted particularly that the data presented in Table 1 represent numbers of admissions to hospital and not numbers of patients with malaria among members of the command. Numerous individuals were admitted to hospital as many as three or four times, and instances were known of eight admissions of the same patient with recurrent malaria. On the other hand many active cases of malaria were certainly included under undiagnosed fevers. It is a fair assumption that the number of hospital admissions gives indication of a number of patients with malaria that is less than fact, rather than greater.

Recurrent Malaria After Primary Infection in America.—Malaria among United States troops in the United Kingdom was reported with more or less regularity from the early days of the Theater. The first case was included in the records of 1942. Because of the great proportion of cases of undiagnosed fever were of malarial nature, the data for that condition are likewise included. The reported frequency of the condition tended to parallel that of malaria, although it is by no means to be assumed that all instances of undiagnosed fever were actually recurrent malaria. The first case of undiagnosed fever was reported in May 1942. (Table 2)

During the course of 1942, 20 cases of malaria were reported among United States troops and 51 of undiagnosed fever. Clinical histories of the patients involved showed them to have acquired their original infection in continental United States, with recurrence taking place in Great Britain.

Despite the influence that might have been expected from the return of casualties from Africa after the onset of that campaign in November 1942, the rates for malaria and undiagnosed fever evidenced no appreciable increase during the early part of 1943.

Importation of Acute Malaria by Crews of Aircraft.—The first event of any considerable importance developed in October 1943. Ten B-24 Liberator crews arrived in England, the first group of the season destined for the Eighth Air Force to fly their planes over the South Atlantic route, since the North Atlantic was the preferred route for bombers during the summer. Of the one hundred officers and men of the crews, 17 subsequently developed malignant tertian malaria. Only the men of one crew escaped infection, and they were the single crew who had been adequately indoctrinated in malarial prevention and had fully practiced preventive measures. Of some crews, as many as three or four of the ten men were infected. The situation was of more than ordinary importance because the crews had been trained to work as a unit and if one member dropped out, the remainder were greatly affected.

The crews of the ten aircraft had recently completed training in America. They flew to Florida, then to Puerto Rico, British Guiana, and to Natal, Brazil. A few planes proceeded from there to Ascension Island and to Roberts Field, Liberia. Most of the Liberators flew directly from Natal to Dakar, but all of the planes whether flying directly or indirectly landed at Dakar and Marrakesh, subsequently arriving in England by way of St. Mawgans in Cornwall. No medical officer checked the physical condition of the crews during the course of their flight. They were sent into regions where malignant tertian malaria was prevalent without satisfactory indoctrination in malaria





Figure 2. Special study of recrudescence and relapse after primary malarial attack, First General Medical Laboratory, England, 1944.





discipline, and in a number of instances without personal protective equipment such as gloves, head nets, mosquito bars and mosquito repellent. The living quarters at Dakar and Marrakesh offered little protection against mosquitoes, and nightly guard duty was required of a part of the men. Few realized that they were taking any particular risk and no chemoprophylaxis had been given. The source of infection was believed to be in either Dakar or Marrakesh.

As a result of this experience, a comprehensive survey of the South Atlantic route was instituted by the Air Transport Command, facilities at the various ports of call were improved, and attention given to malaria discipline. Subsequent importation of malaria from this source was not observed.

Recurrent Malaria Among Troops Returning From Africa and Italy.--Malaria became a problem of distinct medical importance with the arrival of four divisions of infantry and a special brigade of engineers from North Africa. The 1st Infantry Division arrived on 5 November 1943 and was followed shortly by the Ninth Infantry, the Second Armored Division, the 82nd Air Borne Division and the 1st Engineer Special Brigade.

Malarial recurrences occurred among these troops in appreciable numbers shortly after their arrival, to such extent that for December reported cases of malaria had increased to 392, and of undiagnosed fever to 83. The rate for the year 1943 reached 2.54 per thousand for all troops of the theater, in comparison with 0.28 for the previous year. The rate for undiagnosed fever remained essentially the same.

Throughout the winter and spring of 1944, a steadily increased progression was noted in numbers of reported malaria, and to a lesser extent for undiagnosed fever. During the month of May 1944, the 1632 cases of malaria gave a monthly rate of 16.2 per thousand per year. The number of patients with undiagnosed fever was 142 and that rate was 1.41. The decided increase in reported cases in late spring was in agreement with the usual clinical pattern of recurrent malaria, although influenced to an extent by the active preparations then under way for the invasion of the continent. Troops were housed in marshaling areas under difficult living conditions and were participating with increasing frequency in rigorous training maneuvers.

Later Experience in Great Britain.--With the departure to the continent of the four divisions and the special brigade from which malaria had principally originated, the frequency of the disease in Great Britain decreased decidedly. By December of 1944, the number of cases among troops stationed in the United Kingdom was 140 and

the rate 2.3 per thousand per year. Undiagnosed fever evidenced the same behavior, with 46 cases in December and a rate of 0.77.

During 1945 the incidence of malaria in Great Britain receded to the original conditions which held during the first years of the theater. Malaria became a relatively uncommon disease, with rates less than 2 per thousand per year.

The Clinical Disease.--The malaria encountered among combat troops returned from the Mediterranean theater was almost entirely vivax infection. All units had been in service in malarial regions and had been on suppressive atabrine therapy until arrival in the United Kingdom. The malaria that occurred was from recurrent infection. In a majority of instances clear cut histories of previously existing clinical malaria were obtained, but the absence in a considerable number led to the obvious conclusion of parasitism without clinical malaria. Sampling of various groups of patients indicated that the proportion without previous history of attack was about 30 percent.

The experience of the 2nd Armored Division was illustrative of conditions. A survey by personal interview and by examination of the records of the division was made during the last two weeks of April, 1944. Of a strength at that time of about 16,000, 2,454 officers and men gave a history of one or more attacks of malaria, roughly about one-sixth. Men of the division suffering a single attack of the disease, either in the Mediterranean theater or in England numbered 1,782, and those who had a second attack included 672. Recurrences among all persons contracting malaria were thus in the proportion of 27.4 per 100, which is a decidedly creditable record. A single recurrence was noted for 437; 146 had two.

If a history of three or more recurrences is accepted as the criterion of chronicity, only 90 such instances were found among the 672 who had more than one attack and the rate for chronic infections in the complete series was 3.7 percent. The ninety chronic infections included 45 patients with three recurrences, 20 with four and 15 had five attacks. Six patients experienced six separate bouts while one other person had seven and two had eight.

When the dates of initial attack were aligned and properly integrated it became evident that relapses occurred between seven and ten months after the initial infection, most of which had been acquired in August and September of 1943. The high incidence of late relapse in March through June was to be expected because late relapses of this order are known to be characteristic of benign tertian infections.



A group of 57 patients was subjected to special study at the hospital of the First Medical General Laboratory in the spring of 1944. Thirty-two were admitted in relapse, or 56%. The present episode was the first malarial experience for 17, while the remainder had had one or more bouts in the endemic zone. All had been stationed in malarious countries about six months previously. Twelve were admitted in the first recrudescence after a relapse occurring in the European theater. Thirteen infections could be considered chronic in that they had had more than one recrudescence following the late relapse. Six of the patients considered to have chronic infections had been inadequately treated as judged by liberal standards.

The data on recrudescence and relapse after primary attack are presented in Figure 2 for 39 patients of the series who were sufficiently long under observation to give adequate information. An individual may or may not have had a malarial experience in the endemic region. Included as relapse are those cases with long delayed incubation periods.

Primary attack when it occurred is shown in relation to subsequent length of residence in the malarious region. Recrudescence is understood to represent a clinical reaction of sufficient moment to require a course of treatment, as of about the same parasite generation as that of the preceding attack, and recurring within eight weeks. A recrudescence suppressed by prophylactic treatment is one that requires little or no increase in antimalarial drugs to bring about clinical cure. An abortive recrudescence is an episode lasting a day or two which has followed an attack out of the endemic area and requires institution of treatment. Likewise shown are attacks characterized by symptoms of malaria, appearing within eight weeks after stopping suppressive therapy when out of the endemic area and requiring treatment. An abortive escape is an episode requiring no therapy. A relapse is considered as an event occurring more than eight weeks after a previous malarial episode when not an escape attack.

The value of the several observations on recurrence in malaria were particularly favored in this instance through transfer within a relatively short period of time of a large body of men from a malarious area to one where for all practical purposes no opportunity for natural reinfection existed.

For benign tertian malaria the rate of recurrence was not high, and compares favorably with the behavior of civilians living under much less rigorous conditions.

Program of Control in Great Britain.—The decision to return troops to the United Kingdom from endemic malaria areas in Africa and Italy in preparation for the assault on the continent brought full appreciation that a goodly percentage of malaria recurrence was to be expected. Instructions were therefore issued in August of 1943 setting forth principles for the management of patients with malaria.

It was first emphasized that men who had taken suppressive treatment during the period of exposure would not suffer their initial attack in all likelihood until some weeks or even months after the medication was discontinued. For the protection of other patients and in order to prevent spread of malaria to civilian communities within the theater, effective screening of patients with diseases transmitted by mosquitoes was accomplished by keeping the patient under a mosquito bed-net or in a screened room, especially between dusk and daylight. Patients were treated until clinical symptoms of malaria had disappeared and until the blood was free from malarial parasites, as evidenced by two negative thick smear examinations at two day intervals. Thick blood smear examinations for malaria parasites were directed for all patients who had had recent duty in overseas endemic areas, irrespective of whether or not they gave a history or presented symptoms of malaria. Carriers detected by these examinations were treated until the blood was free from parasites. Before discharge or the granting of furlough or sick leave, patients with a history of malaria were warned that they were liable to a recurrence at some future time and should have a blood examination for malarial parasites in the event of any febrile illness. Intensification of mosquito control operations was directed in and about station receiving troops from overseas areas where malaria was endemic.

Shortly thereafter, in September 1943, comprehensive directions were issued by the Division of Professional Services concerning the drug treatment of malaria both as a suppressive and in the management of clinically definite infections.

Detailed information was provided medical officers on various features such as the relative efficacy of atabrin, quinine, and plasmochin, on the adverse effects occasionally noted in the use of these agents, and on the need for conservation of quinine. Drug suppressive treatment was defined as an emergency procedure to be employed only when troops must accomplish a particular mission in an area where the risk of malaria was substantial and where protection by mosquito control measures was not possible. It was stressed that at present no drug was known which in safe doses would prevent mosquito transmission of malarial infections, but that atabrin taken regularly and in proper doses could be expected to suppress clinical symptoms



for varying periods of time, thus enabling men to remain active in spite of infections which otherwise would incapacitate them. When troops returned to areas with proper protection against mosquito-borne disease, suppressive treatment should be discontinued as soon as feasible. Further attention was given to the management of the clinical attack in respect to both complicated and uncomplicated malaria. The treatment of relapses and recrudescence was given particular attention.

The increasing moment of this problem in late 1943 brought about intensification of the general measures which had already been defined. The immediate consideration was in respect to the general military population of the United States Army, which even then was being pointed toward the campaign on the European continent. The second consideration related to the British civilian population, in that the United States Army had a definite obligation to assist in preventing a recurrence of even such a mild outbreak of malaria as occurred following the previous war.

The program that was put into practice was based on four general principles. Emphasis was first placed on the prompt treatment of patients with malaria to render them noninfective to mosquitoes as quickly as possible. The second measure involved the use of atabrine as a suppressive of malaria. Thirdly, action was taken to protect other patients in hospitals and troops of nearby regions from contact with malaria-transmitting mosquitoes when patients with malaria were under treatment. Finally, control of mosquitoes in the general military area was intensified as a general protective measure for the health of the command. The first two objectives fell within the obligations of the Division of Professional Services, the last two were functions of the Preventive Medicine Service.

The increasing frequency of chronic relapsing malaria within the theater led to the publication of directions for the management of patients convalescent from that condition, with particular attention to diet, rest, and to rehabilitation.

The control of mosquitoes, particularly in hospital areas and in regions occupied by the troops affected, was brought about by field studies by the entomologists of the central division of preventive medicine, by coordinated effort with the Corps of Engineers and through comprehensive directions for the information of the command.



Consideration was given to a selective choice of hospitals through a policy of admitting patients with malaria only to installations located in areas essentially free of anopheles mosquitoes. Because of the time of the year when the problem presented, namely the autumn of 1943, it was not deemed essential to seriously consider such a procedure until the following summer. The difficulties which any selective program of hospitalization introduces into a scheme of evacuation requires that the need be definitely defined and out-weigh the military disadvantage. By the time the next mosquito season arrived, most of the troops with malaria had departed for the continent, malaria in Great Britain was declining rapidly and the matter was dismissed from consideration.

The increasing numbers of recurrent malaria that came in the spring of 1944, and the assignment of the seasoned troops most affected to lead the invasion of France, required energetic measures to reduce the number of non-effectives from malaria among these highly important tactical troops, if they were to be in a state of greatest usefulness. Individuals debilitated by reason of relapsing malaria were removed from combat units during the final training period in Great Britain. About two weeks before departure for Normandy all personnel with a history of malaria within the past twelve months were required to resume atabrin suppressive therapy. The dosage was increased from 0.4 gm. weekly, to 0.1 gm with the evening meal each day except Sunday, and was to be continued indefinitely. Supplies of atabrin sufficient for 14 days were issued to all soldiers with a history of malaria at the time of embarkation for combat duties.

Other significant changes made in the management of malaria just prior to the Normandy D-day included the recommendation that specific antimalarial therapy was to be delayed until confirmation of the diagnosis by demonstration of the plasmodium whenever feasible and without danger of injury to the patient.

Two prescribed routines for the treatment of malaria with quinine and with atabrin were outlined, and information was given on the treatment of cerebral malaria and on the management of convalescents.

Reassignment for limited service was recommended for patients with a history of three or more relapses, who showed a persistently palpable spleen, failure to regain accustomed weight, persistent mild anemia, or general lowering of resistance and depreciated physical status. Evacuation to the Zone of the

Interior was recommended for patients with a history of three or more relapses where debility, malnutrition, anemia, and splenomegaly were so pronounced as to render them obviously unfit for useful service in the theater.

Suppressive therapy in relapsing malaria was increased to 0.10 gram daily, beginning in the fourth week of hospitalization and continuing thereafter for three months under supervision of the unit medical officer.

Malaria in Continental Western Europe.--In modern times malaria had not been a problem in the areas of France lying within the proposed zone of operations for the invasion of Europe. Although anopheline mosquitoes were to be found in northern France serious danger of malaria was not to be anticipated north of Quimper on the Brittany peninsula.

Thorough review of all available sources of information in the course of medical planning gave assurance that the malarial problem in further extension of operations in northern Europe was likely to be minimal. Belgium was essentially free from the disease, and Germany had had little malaria for many years. Only the Netherlands continued to have malaria to an appreciable extent. Conceivably the flooding of that country in the face of successful advance by allied troops would further aggravate conditions. This was the one country of possible operations where malaria had not largely disappeared.

France was the country of principal concern because operations were to begin there. During the last five decades, malaria had been steadily disappearing, leaving only a few scattered areas with a mild degree of endemicity. Benign tertian malaria occurred almost exclusively, although occasionally quartan and even falciparum infection had been recorded. The principal areas were stated to be in Brittany, the coast of Vendee, Gasogne, and the Mediterranean littoral. Some few isolated foci were still maintained in the interior.

The malaria situation in the countries of northwest Europe as it existed at the time operations started, according to available medical intelligence, is set forth in Figure 3. The invasion of continental Europe was initiated with rather certain assurance that malaria would be of little more importance than it had been in Great Britain.



Frequency of Malaria in the United States Army During Operations in Western Europe.--The question of how much of the malaria among United States troops on the continent of Europe represented primary infection of indigenous origin and how much was referable to recurrence of to primary clinical manifestation after infection in other regions, was not as easy to answer as it had been in relation to experience in Great Britain. The available medical records do not distinguish indigenous and recurrent infections; and evaluation necessarily dependent on the general opinion of medical officers serving with troops, and on individual case reports.

No cases of indigenous malaria were known to have occurred in Great Britain. Some few did occur in France, but the number was not susceptible to even rough approximation. The surgeon of the First United States Army was of the opinion that no indigenous infections were represented in reported malaria in the First Army, in Normandy or subsequently. All of the units coming from malarious areas served with the First Army and most of the malaria occurred in that organization.

In southern France, in Delta Base Section, occasional instances were rather definitely marked as of local origin, although the number was certainly small. No question can arise that the great proportion of the malaria reported among United States troops in France was representative of recurrent infection, almost to exclusion of all else. The proportion of indigenous infections would almost surely be less than one percent of reported cases.

No separation of malaria reported on the continent from that occurring in Great Britain was available for the month of June 1944, the first in Europe. For the theater as a whole, 1517 cases of malaria and 292 of undiagnosed fever were determined, which together essentially duplicated the frequency during the preceding month of May. July had 1915 cases, of which 1381 were among continental troops. The rates were inordinately high, 266.4 per thousand per year, since the strength was relatively small and largely composed of veteran divisions heavily seeded with malaria.

The subsequent behavior of malaria is set forth in Table 3, showing the incidence of malaria on the continent and in Great Britain for the period of September 1944 to June 1945, inclusive. Rates on the continent decreased sharply to reach 5.1 per thousand strength in November 1944. The number of cases was materially less, but the principal effect on the rates came from the huge additions to continental troop strength.





Figure 3

Distribution of indigenous malaria in countries of Western Europe, showing areas of high and low endemicity.



Malaria cases essentially doubled during December 1944, because of the inclusion at that time of the forces of the Mediterranean Theater which had entered France from the south during the preceding August. These troops included three divisions of infantry with high malaria rates dating from their experience in Italy.. The theater rate was not greatly affected, rising from 5.1 to 6.8, because of continuing additions to troop strength.

Conditions were somewhat improved during the winter months of January and February, but March 1945 saw a strong upsurge in both numbers of cases and rates. The number of cases was 2142, the rate 10.0. For the theater as a whole 2211 cases of malaria and 1550 of undiagnosed fever were reported, with rates for the two conditions of 8.36 and 5.9. The greatest number of cases for any single month of the theater experience was 2526 in May, with an additional 1934 cases of undiagnosed fever.

A most significant feature of the experience of the spring of 1945 was the disproportionate increase in reported cases and rates for undiagnosed fever, (Table 3) as compared with the previously existing ratio between that condition and malaria. This was influenced in large part by the customs of reporting in the Seventh Army.

The redeployment of troops to other theaters and to the Zone of the Interior began in May, and early involved the veteran divisions of the First and Seventh Armies which had furnished most of the malaria. The incidence for the theater decreased sharply with the change in population that took place, so that for the following October only 66 cases of malaria were represented in the theater experience; and for December 1945, only 2 patients with malaria were admitted to hospital. Malaria had ceased to be a problem.

Causes of Recurrence and Relapse. --Because of the known presence of anophelines in the area occupied by the First U. S. Army in July (Normandy) the question of new cases arising from our own reservoirs was given full consideration. Although the best available opinion indicated no danger of spread of malaria in the part of France concerned, all patients discharged from hospital after malaria were put on atabrin when returned to their units.

Case studies showed that all patients who developed malaria had previously been in malarious regions. In Normandy,



under the rigorous conditions of the St. Lo campaign, and not at the time on suppressive treatment, they developed clinical disease. Theoretically, recurrences should not have occurred since all were supposedly on atabrin management. With few exceptions patients admitted that they had not been taking the drug. Various explanations were given by officers and men. Many said atabrin was not available under combat conditions when separated from their units. Others objected to the drug because it disagreed with them, or caused various unpleasant symptoms; therefore they did not take it. It is believed that there would have been few recurrent cases had all personnel with a history of malaria been provided with atabrin and adequately indoctrinated with the necessity for taking it.

The decline in malaria in the First Army after July and August was believed due principally to the depletion of the reservoir of parasitized individuals as the result of death or evacuation from the army area. The policy of two full weeks of vigorous quinine therapy which was inaugurated on 30 July 1944 by the First Army undoubtedly had an effect, as did increased emphasis on atabrin suppressive therapy. Improved climatic conditions likewise contributed.

Corroboration of the expressed opinion of medical officers of the First Army, that laxity in malaria discipline with failure to take atabrin prophylactically was the chief reason for recurrences, was obtained by survey of a group of 94 patients evacuated to a general hospital in Britain in July 1944. The number of patients with a previous history of malaria was 78, of whom 21 claimed to have been on atabrin and 57 had not. Sixteen of the group had previously experienced no clinical manifestations of the disease; and the number who had taken atabrin was 3, and 13 had not. It appeared that most of the attacks had occurred after soldiers ceased taking the malaria suppressive treatment, although an appreciable proportion represented breakthroughs, in that attacks developed during the course of treatment.

Epidemiologic Aspects of Recurrent Malaria in the European Theater of Operations.---The malaria of the European Theater was almost entirely recurrent malaria. The cases were contributed in almost their entirety by seven divisions together with attached troops, which came from the Mediterranean Theater. Three Infantry Divisions, an Armored Division and the 1st Engineer Special Brigade arrived in the United Kingdom in November of 1943. The malaria rate for the theater had been negligible before their arrival. It promptly increased to the extent of a major medical problem.

The troops of these divisions spearheaded the invasion of Normandy. Despite previous elimination of the men most affected by malaria, and the requirement of atabrin suppressive treatment for those with a history of the disease, the attack rate increased greatly in the early months of the campaign.

The theater rate was again affected adversely when three divisions of infantry from Italy with attached troops became a part of the theater forces in November 1944.

The effect which these heavily seeded divisions had on the incidence of malaria in the theater is best illustrated by examining the individual histories of the units in respect to the disease. The experience of the 1st Infantry Division and of the 2nd Armored division will be used because of the satisfactory and complete records available from the time of their entrance into action in another theater until operations in the European Theater ceased. Particular interest attaches to these observations because rarely are circumstances such that a large body of men are suddenly transported from a highly malarious region to what for all practical purposes was a region free from malaria.

The 1st Infantry Division.—The 1st Infantry Division arrived in the United Kingdom from the Zone of the Interior in August 1942. The unit remained in England until November when it sailed for Tunisia. Malaria had been no problem up to that time nor was it during the campaign in Tunisia, since no more than 25 to 30 cases of malaria occurred during the several months in that country. Some few cases were noted in Algiers in May 1943 when the division moved into Oran in preparation for the assault on Italy. (Figure 4)

Scarcely had the 1st division landed in Sicily 10 July 1943 when the rate for fevers of undetermined origin rose precipitately. How much of this observed frequency was due to malaria and how much to sand fly fever remains unknown, but the rate for malaria paralleled that of undetermined fever although never approaching it in amplitude of curve.

Malaria was prevalent during the voyage to England in late October after the conclusion of the Sicilian campaign. Many recurrent infections were reported after arrival in that country. The spring of 1944 was accompanied by a decided increase in the frequency of malaria just before D-Day, a most distressing circumstance because the troops occupied an important place in plans for the initial assault.



The early days of the campaign in France were characterized by rates which exceeded, beyond all comparison, those of the original experience in Sicily and despite the dilution brought about by heavy replacements from battle losses. Malaria continued to be a significant medical problem of the division throughout the year, and even in the spring of 1945 the rates were still high.

Malaria in the 2nd Armored Division.—The 2nd Armored Division landed in French Morocco, North Africa from the United States in December 1942. The division was faced with a serious malaria problem from the beginning. During January 1943 the malaria rate reached 235 per thousand per annum.

For the first four months the division was bivouaced about twelve miles east of Rabat. Scattered throughout the area were numerous ponds, breeding anopheles mosquitoes in great numbers. Although no actual epidemic of malaria existed in that part of Morocco, local sources of information revealed many chronic malaria carriers in the area, that the adult mosquito population was infected, and obviously the newly arrived troops were highly susceptible. In spite of all protective measures 90 cases of malaria were reported in the division during the week ending February 5. (Figure 5.) Subsequently the number decreased rapidly, to reach a low point in April.

With the onset of warm weather the expectancy had been for an increased incidence. Several factors were responsible for the dramatic arrest of the disease. The ponds became smaller and some dried up completely, which reduced mosquito breeding. Soldiers of the division also became more concerned about the dangers of the disease and learned how to protect themselves from mosquitoes. Perhaps the most important single factor was the energetic control of mosquito breeding by the newly organized malarial control unit of the division.

Units bivouaced near the worst breeding places had always had the highest rates and these units showed the most dramatic improvement after control measures were put into effect. In late April atabrin suppressive treatment was started according to existing regulations for the North African Theater. Because the division was not in combat and because of the excellent results already obtained through mosquito control, the atabrin program was not warmly received.

An entirely new environment was encountered in May when the division moved to the region of Porte-aux-Poules, Algeria. Although the terrain was primarily rocky and dry, mosquitoes were present in tremendous numbers. The bivouac was unfortunately close to a large swamp area, approximately 30 miles in extent. Mosquito



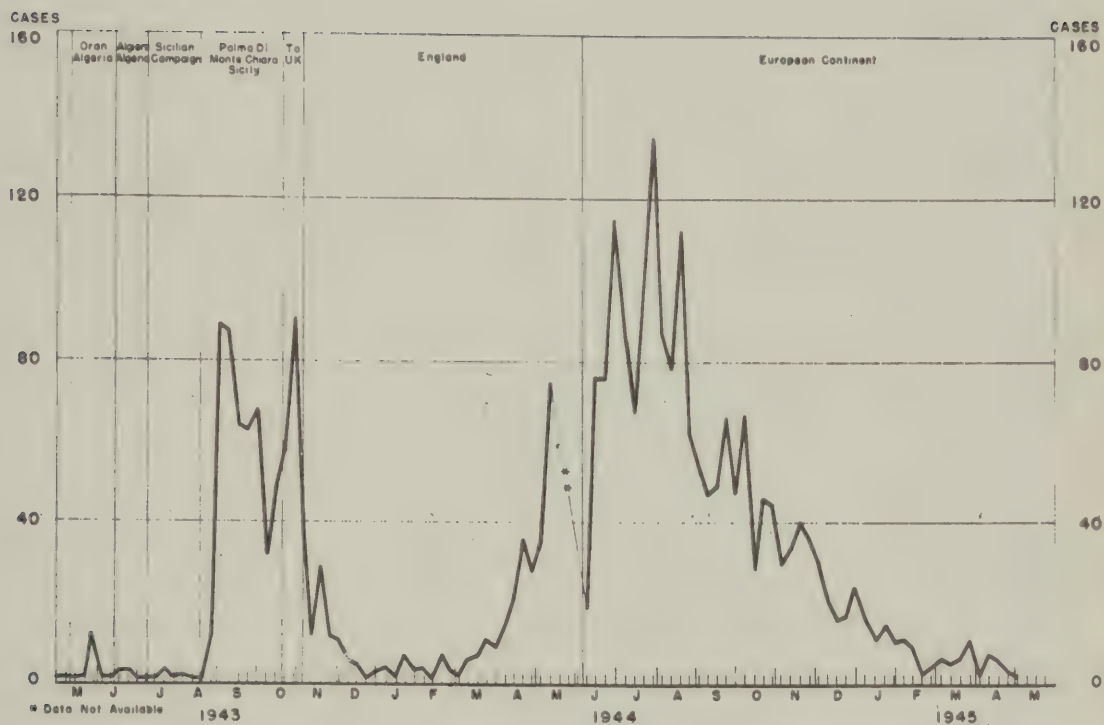


Figure 4

Malaria in the 1st U. S. Infantry Division, North African and European Theaters of Operations, rates per 1000 strength per annum, by weeks, May 1943 to May 1945.



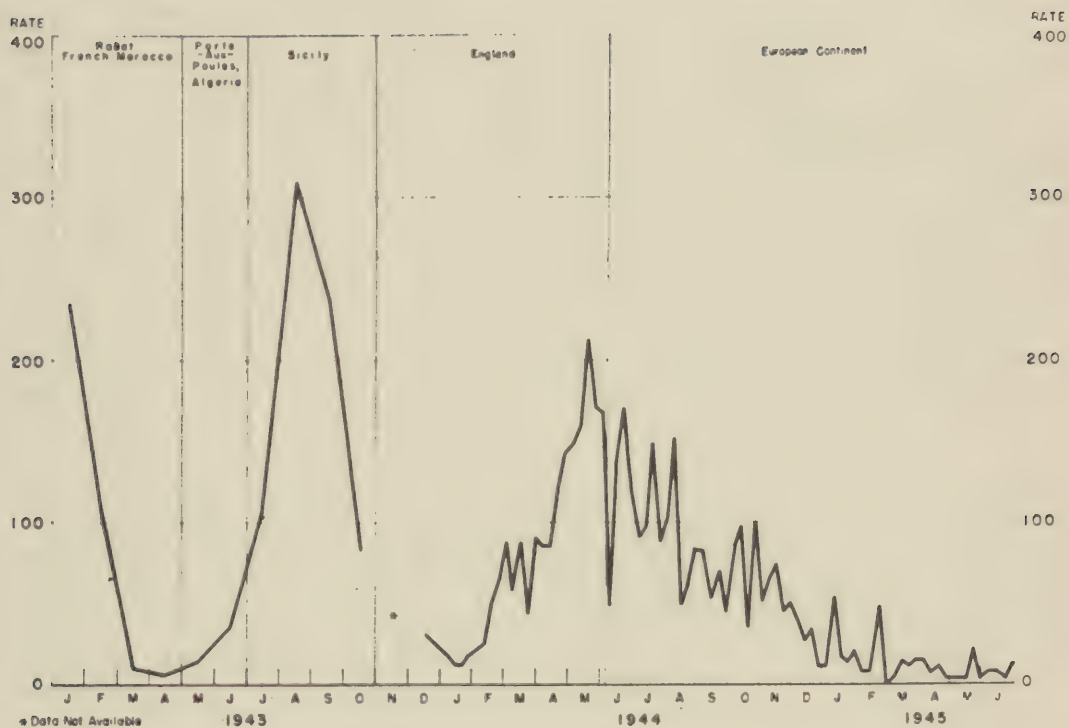


Figure 5

Malaria in the 2nd Armored Division, North African and European Theaters of Operations, rates per 1000 strength per annum, by weeks, January 1944 to June 1945.





breeding was unbelievably great and although culicines were most common, surveys showed anophelines. Control was difficult by reason of the division being engaged in intensive amphibious training maneuvers. With considerable moving about and frequent night problems in preparation for the invasion, malaria again became more frequent in June.

Most of the 2nd Armored Division took part in the successful invasion of Sicily in July while the remainder moved to the region of Bizerte. The Sicilian campaign proceeded rapidly and by the first of August most of the units of the division were well established in bivouacs along the northern coast of the island and west of Palermo, while other units were dispersed over a wide area around Corleone and Frizzi engaged in active patrol duties. The week ending 7 August reached an all time high in newly reported malaria, with 129 cases confirmed by blood examinations for the Sicilian portion of the division and 21 cases for the third of the division in Africa. For the entire division, the rate for August was 309.

Many patients in July were reported as having fever of undetermined origin or as possible malaria because proper diagnostic facilities were not available to units in combat. The later precise determination of the nature of these illnesses accounts in large measure for the apparent abrupt increase in malaria in August, and likewise indicates that the rate for July was much more than the recorded rate of 106 per thousand per year.

The malaria rate was greatly improved by the middle of October when the onset of the rainy season virtually put an end to the mosquito breeding control program. The division embarked for England in early November.

The history of the division in the United Kingdom was much like that of the 1st Infantry Division. Malaria was common immediately after arrival, the winter was marked by a favorable improvement but a marked increase took place in the spring just before D-Day and again in France during the early months of the campaign. The better record which followed was related in large part to the extensive replacement of individuals infected with malaria as the result of casualties, and of course to the natural evolution of the disease.

Malaria in the Seventh Army.--The second principal influence on the malaria rates of the European Theater came from the addition to the theater forces in November of 1944 of the task force from the Mediterranean Theater which had landed in southern France. These troops were heavily infected with malaria, if anything more so than those which had earlier transferred to England. They had been subjected to longer continued exposure.

Lacking available individual records of the three divisions which made up that force, the frequency of malaria and the impact on the rates for the theater can best be determined by assessing the behavior in respect to malaria for the force as a whole. The number of troops entering France from the Mediterranean during the period 15 August to 1 November when the contingent became a part of the European Theater, was 122,088. The cases and rates for malaria according to currently existing strength are shown in Table 4, for the days in Naples immediately preceding operations in France, for the period in France when the force remained under the control of the Mediterranean Theater and for the remainder of the war as a part of the Seventh Army of the European Theater.

The frequency of malaria in the Seventh Army was representative of malaria in the troops exposed to the disease in Italy until 10 November 1944, when fresh troops from America first augmented the Seventh Army. Since malaria in the Seventh Army as a whole was almost completely a factor of the original troops, the rates were consequently greatly diluted. To give a clearer idea of the progress of the disease, rates are presented in column 4 of Table 4 computed from reported cases and the average strength of the original force. This procedure also gives a figure measurably below actual fact, because no allowances is made for losses of the original force from battle casualties, non-battle injuries, and diseases other than malaria. However, the rates on this basis are still great and represent more nearly the course of what took place.

The number of troops entering the theater in the first force which came to England was 51,787 and through France by way of the Seventh Army about 122,088, a total of 173,875. Service troops and separate units served to bring the total to about 306,459, a figure which is likely low because of casualties and small units that were missed. If the rates for malaria are based on this strength some 24,660 cases of malaria occurred among 306,459 troops exposed to that disease in Africa and Italy and the rate for malaria was about 115 per thousand per year.



Comparison with other Theaters of Operation.---Despite the practically complete lack of acquired malaria the frequency of recurrent malaria led to the European Theater having a position of seventh among Theaters of Operation in rates for malaria. The highest rate during the war was that of the African Middle East Theater which was closely followed by the Far Eastern organizations. The Mediterranean rate was high but that in the China Burma India area was decidedly good. Little malaria was noted in the American theaters. Table 5.

Control Measures on the Continent.---The same general principles that had been defined for the management of recurrent malaria in Great Britain continued to guide activities in the more extensive problem presented in the early months of operations in France. Atabrin suppressive therapy was directed for all personnel with a previous history of malaria. The principles of medical management continued as described in instructions issued just prior to D-Day. Administrative practice was altered early in the course of operations in regard to the evacuation of patients.

On 22 June 1944, the evacuation policy of the First Army was changed to a 10 day basis, which meant that if patients when first seen were judged to require more than ten days hospitalization they were evacuated to the rear. In order to conserve manpower and to keep in the army area as many men as possible, malaria was divided into two groups, complicated and uncomplicated. Complicated malaria involved patients with cerebral malaria, those with a history of three or more relapses who showed symptoms of persistently palpable spleen, failure to gain accustomed weight, persistent anemia and general lowering of resistance of physical status. Patients with complicated malaria were treated until transportable and then evacuated.

Simple, uncomplicated cases were initially treated in the evacuation hospitals of the army, until subsequently a particular field hospital was designated as a malaria treatment center. Patients were given a full two week course of treatment with quinine and a period in the convalescent hospital before returning to duty on suppressive atabrin therapy.

Protection of Patients with Malaria from Mosquitoes.---Many of the newly established hospitals in Normandy were under canvas and almost without exception they were in improvised quarters. Several inspections were undertaken to assure that all were familiar with the need to protect patients with malaria from contact with mosquitoes. Action was also instituted to

remedy the occasional deficiencies in supplies to accomplish that end, such as bed nets and mosquito bars.

✓ Mosquito Control.--A sanitary survey of the proposed invasion area made shortly in advance of operations and based on intelligence reports, revealed that large areas along the coast and the low lying sections of the Normandy peninsula were flooded. Under these conditions troops entering the area would likely be under considerable annoyance from mosquitos. Since anopheline species were indigenous to the region, consideration was invited to the possibility of promoting an epidemic of malaria since many of the troops destined for action there were malaria carriers. A period of cool weather during the latter part of June and early July 1944 eased the situation.

A field survey of the region in mid-July gave evidence of Anopheline larvae in the vicinity of Carentan. Further identification was not made but it was presumed for the time that these were atroparvus. The distribution was believed to be spotty and related to the flooded areas near Carentan which were then receding, a circumstance which could be expected to have a favorable effect on mosquito incidence. Information obtained from local French physicians indicated little malaria among civilians of the region.

At the request of the Surgeon, Ninth Air Force, a representative of the Preventive Medicine division made a survey of the area during the latter part of July to determine feasible measures of control. Breeding of mosquitoes was extensive throughout the area but the institution of general large scale control measures such as airplane dusting was deemed neither necessary nor practicable. Repellent sprays and bed nets were recommended for hospitals and for some of the static combat units, such as anti-aircraft gun crews and ground crews of the air corps.

The species of mosquitoes most commonly found were culex pipiens, Aedes caspius, Theobaldia annulata, anopheles of the maculopinnis group, both the fresh water breeder, messeae, and the brackish water breeder, Labbranchiae atropavus. The last named species was found breeding in enormous numbers in pools left by the receding flood waters, a sufficiently high mosquito population to support a malaria epidemic was believed unlikely despite the numbers of recurrent malaria cases among American troops. No cases of indigenous malaria were reported among American troops that summer. The British to the north around Caen had some 40 cases, with about 500 cases among civilians.




The addition of large areas of southern France to the territory of the theater in November 1944 brought a malaria district of more serious proportions, actually the only part of France where malaria was of any particular consideration. Figure 6. An aerial survey of the coast during the latter part of February indicated favorable mosquito breeding places in the vicinity of areas where American troops were stationed, particularly those around Miramas, and the Marignane and Istres Airports. Considerable difficulty from salt water breeding Aedes was also anticipated in the localities farther east where recreation centers were being established.

A concerted mosquito control program was therefore initiated by the Delta Base Section, beginning about 15 April 1945, to prevent mosquito breeding within a five mile radius of the three areas mentioned. When staging areas for the re-deployment of troops were established in the Marseilles district, still nearer the heaviest anopheles breeding places, control operations were necessarily greatly expanded. About 900 German prisoners of war and Yugoslav laborers were employed in ditching and clearing the affected areas. Airplane dusting with DDT was used extensively. Mosquito bars, repellents, aerosol bombs and DDT residual effect sprays were employed in barracks, tents, and buildings.

Since a number of the recommended procedures were of recent development and not always familiar to medical and other officers, specific directions for their use were issued as a theater directive. As a further aid in the application of preventive measures against malaria, the comprehensive Technical Medical Bulletin of the War Department on that subject was re-published as a circular letter of the Office of the Chief Surgeon.





Plague.--No American soldier stationed in the European Theater ever contracted plague. As a matter of fact, plague was absent from the United States forces throughout the world during the whole course of the war. Furthermore no plague infected rat was ever identified on board a United States ship during the course of active operations.

The first threat of plague came when troops of the theater were stationed in Great Britain. This infectious disease appeared in the Azores Islands during the autumn of 1942, when 54 cases occurred among natives. It reappeared in lesser numbers in 1943 when American troops were stationed there and again in 1944. The sources of infection were well removed from islands where United States troops were located and the danger was actually minimal because of the energetic action taken at American installations to eliminate rats and fleas. The possibility nevertheless existed that plague might be imported into Great Britain because of the extensive air travel which came through the Azores. Ports of entry for international air traffic were advised of the situation and emphasis was placed on sanitary inspection of airplanes and the control of passengers arriving in the theater by way of those islands.

The territory lying along the Suez Canal was a recognized plague area of long standing. The disease had last been reported in 1932, the Suez remaining free from plague until 1939. Some few scattered cases were reported at that time and there is every reason to believe that an epidemic began to build up from then on, because each year a few scattered infections occurred. A serious epidemic developed in November of 1943. The disease spread northward, involving a number of towns and villages, and eventually became epidemic in Port Said in April 1944. In all, the number of cases in the area during the winter of 1943 - 1944 was 1581. The heavy shipping passing through the Suez Canal made the existence of this relatively remote outbreak of more than usual concern to the European Theater.

Dakar and West Africa generally had a long history of plague. The region was a characteristic and recognized endemic focus of the disease. The war brought a generally decreased emphasis on rat control from 1939 to 1944, and there was general agreement



Figure 6

Search for malaria vectors, Marseilles district, April 1945.





among local observers that the rat population of Dakar had increased measurably. It was therefore not surprising that plague appeared in the city on 20 April 1944 and that rather typically the first infection involved a native occupying a guard hut near the docks of the arsenal district. The outbreak reached its height in mid-summer, with a gradual decrease in number of cases during the autumn months so that the last case of plague in Dakar was noted on 24 November 1944. The number of persons infected, all civilians, was 566.

A small outbreak of plague in Oran in early 1945 was of still more intimate concern to health authorities of the European Theater, because of the extensive maritime and air traffic between the North African coast and the French port of Marseilles. The outbreak in Oran was a part of a general increase in plague along the North African coast which started in Ferryville in the autumn of 1944. The first recognized infection in Oran was on 29 December 1944, with death of the patient in the early days of January. Subsequently, eight other natives contracted plague, all of the pneumonic form.

Plague of both bubonic and septicemic forms appeared in Casablanca on 20 July 1945. The outbreak was limited to three cases, two natives and one European, with no cases among American soldiers stationed in the city. The reported cases occurred within a single week, which speaks for the efficiency of the control measures employed.

Epidemiologic Investigations.--The presence of plague in a number of African ports led to several instances of suspected plague on ships calling at French ports. The SS Batory left Algiers, then a plague port, proceeded to Great Britain and subsequently called at Morlaix on 21 October 1944. A French soldier had died enroute, and the ship carried United States Army personnel. Investigation of the circumstances at the port of call in Great Britain revealed a death from septicemia believed not to be plague, but remaining unconfirmed because proper specimens were not taken for bacteriologic examination. No case of plague developed among French or American personnel. Contacts had been isolated immediately and the entire personnel inspected daily. Inspection at the port of Plymouth by British Health authorities revealed no suspicious cases. At Morlaix all passengers and crew were examined, with no reason to believe that plague had existed or was present on board the ship. No dead rats were found and the sanitary condition of the ship was satisfactory.

On the 7th of November 1944 the SS Alfred Moore arrived at Marseilles with report of the death of a French soldier at sea

from an illness suspected of being bubonic plague. The ship was placed in quarantine pending inquiry. Pathological and bacteriological examinations of tissues obtained at autopsy of the patient failed to reveal evidence of plague. Despite the laboratory report the ship was treated with DDT residual spray and personnel were dusted with DDT powder. No secondary infections occurred among contacts during the time the vessel was quarantined in the outer harbor.

Several ships engaged in traffic from North Africa during the Spring of 1944 called at the port of Agaccio in Corsica where plague had been identified. On arrival at Marseilles quarantine was practiced before passengers were disembarked.


No reported case of plague went uninvestigated. Perhaps the greatest number of suspected cases arose from errors in compiling the Weekly Statistical Report. The item pneumonia directly followed that of plague on the prepared form, with the result that from time to time a clerical error caused a case of pneumonia to be reported as plague. The location of the unit ordinarily served to identify the probably nature of the circumstance, but individual investigation was nevertheless made.

In all instances of reported plague in the course of maritime traffic arriving at ports of the European Theater, confirmation of the diagnosis remained indefinite. It is doubtful that the European Theater was ever directly exposed to the danger of plague infection.

Control Program.--Because of the particular circumstances which made Marseilles particularly susceptible to the introduction of plague, Delta Base Section maintained a continuing program of rat control measures, utilizing a four man team in and around the city. No plague infected rat was ever identified.

A comprehensive program for the control of plague was prepared in anticipation of possible difficulty. The experience at Dakar had demonstrated the usefulness of DDT as a means of direct attack on the flea through disinfestation of persons and premises, rather than the indirect approach through rat control. The later experience at Oran confirmed the usefulness of sulfadiazine as a chemoprophylactic agent in management of contacts. These important additions to the program of plague control were combined with recognized measures of immunization, quarantine, and rat control.





Trench Fever.--Medical intelligence reports of early December 1944 indicated that the German Army in the Netherlands was experiencing a five day fever sometimes termed Wohlhynian fever. It appeared to have occurred over the past three years and to have been observed also in Greece and in Russia. At times as many as 15 percent to 20 percent of troops of a command were affected. It was rarely fatal. The chief clinical features were described as pain and tenderness of the legs and over the lumbar region; with some headache and prostration during the fever. The temperature was commonly elevated for a week, and tended to reappear suddenly after five or six days. The total duration of the illness was sometimes as long as two or three months. The disease was considered to be transmitted by body lice.

The clinical features of the condition described were similar to those known as Trench Fever in World War I, a febrile illness of rapid onset with temperatures reaching 103° F. and 104° accompanied by dizziness, severe headache, eye pain, conjunctivitis, and occasionally leucocytosis. The feces from lice fed on patients had been shown to be infective.

The intelligence reports were passed to Surgeons of armies for their information, since the Germans had experienced this infection in the areas where some of our armies were then engaged. Routine inquiry was made of captured German medical officers and of prisoners of war from the enemy medical department. No evidence was ever obtained that the infection existed among American soldiers, nor that the disease was prevalent among the German military command engaging American forces.

Only twice in the history of the theater was a case of Trench Fever reported, one being from the 15th United States Army on 1 June 1945 and the second in July 1945. Confirmation of the diagnosis was never obtained in either instance. As a matter of fact, these were the only two cases of trench fever reported in the U. S. Army in the course of the war from all theaters.



Pappataci Fever.--Sandfly fever was not a disease indigenous to any part of the area included within the European Theater. The disease was reported among troops who arrived in southern France from the Mediterranean Theater in the course of Operation Anvil. Thirty-three patients were admitted to the 27th Evacuation Hospital between 1 September and 20 September 1944, mostly from a single unit. With the movement of troops northward, the advent of colder weather and the absence of the sandfly vector, no more cases occurred. The diagnosis was made by medical officers long familiar with the condition through experience in Italy and Sicily, and the outbreak occurred shortly after the men arrived in the theater. There is no reason to doubt the nature of the condition.

During 1945, two cases were reported in May and five in June.

In the African-Middle East Theater this disease constituted a principal medical problem, with an average annual rate of 25.75. Sandfly fever was relatively frequent in the China-Burma-India and Mediterranean Theaters, but largely absent from other areas of influence. (Table 6)

Relapsing Fever.--Relapsing fever has never been reported with any considerable frequency in Great Britain or in the territory included within countries of northwest Europe. During the course of operations, only two cases of relapsing fever were incorporated within medical records of the Theater. One case occurred in Great Britain and the other on the continent.

EPIDEMIOLOGIC CASE REPORT NO. 1. An enlisted man serving with the 280th Station Hospital since February 1944 was admitted to hospital on 7 August 1944 with the complaint of loss of appetite of four or five days duration, drowsiness, and fever for one day. His temperature was 103° F., the throat moderately injected, and a sparse maculopapular eruption was generally distributed over the body. An intermittent fever reaching heights of 102° F. and 103° F. occurred each evening until 14 August, accompanied by transitory inflammatory joint involvement. The generalized skin eruption continued, with new lesions appearing each day and progressing through a series of changes from macules to maculopapules and gradually fading with a residual pigmentation. The blood was negative for malarial parasites. After a week of freedom from fever, he

was readmitted on 27 August with a temperature of 103.2° F., complaining of headache, and tenderness and aching of the legs. The skin eruption was again evident and the course was characterized by daily fluctuations of temperature from 98° F. to 103° F. Dark field examination of the blood revealed motile organisms similar to *Borrelia recurrentis*. Similar though imperfectly stained spirochetes were found in stained blood smears. Mouse inoculation resulted in illness of the animal and spirochetes were found in the blood. The diagnosis of relapsing fever was made. The history gave no evidence of louse or tick bites prior to the onset of illness, nor had there been known contact with insects or animals. The patient had slept in a haystack about a week prior to the onset of his illness and the rash appeared a few days later.

For all theaters, the disease was uncommon. The number in Continental United States was 25, and for overseas theaters 159. The majority were in the China-Burma-India theater, 91 in all, while 37 occurred in the Mediterranean Area and 22 in the African-Middle East Theater. (Table 7)

Dengue Fever.--Dengue fever was not indigenous to the area included within the European Theater and no cases were known to have been imported through arrival of troops from the Mediterranean or other areas.

Leishmaniasis.--Four patients with Leishmaniasis were admitted to hospital during the course of operations in Europe. Three cases determined in Great Britain were representative of the visceral form of the disease. An instance of cutaneous leishmaniasis was observed in a soldier serving on the continent. All four patients gave a history of previous service in Africa.

EPIDEMIOLOGICAL CASE REPORT NO. 2. An enlisted man took part in the African and Sicilian campaigns. He returned to England in October 1943. With the exception of mild diarrhea in Sicily and enroute to England his health had been reasonably good until 2 December 1943. He then had shaking chills and fever with a slight cough, but no other complaint. The symptoms continuing, he was admitted to hospital on 6 December 1943 with a temperature of 105° F. Blood studies showed 4.2 million red blood corpuscles and a white blood count of 6,200 with 55 per cent polymorphonuclear leucocytes. The patient continued a remittent fever, varying



between 102° F. and 104° F. with almost daily chills. The number of leucocytes decreased to the 4,000 level, with slight lowering of polymorphonuclear cells to about 40 per cent. A moderate anemia developed and on the 12th day of the disease a therapeutic trial of atabrine had no effect. On 19 December the spleen was noted to be about two centimeters below the caustal margin on deep inspiration. There was a slight generalized lymphadenopathy. Sternal bone marrow smears revealed leishmania both inside and outside cells. A splenic puncture on 15 March 1944, served to reveal leishmania on direct smear and culture.

EPIDEMIOLOGICAL CASE REPORT NO. 3. An enlisted man was admitted to hospital 8 January 1945, complaining of an ulcer on the left wrist of nine months duration. He had service in the North African campaign, including a short term in Corsica. In mid April 1944, he noticed a pea sized painless lump just above the styloid process of the left wrist. This gradually increased in size and broke down to form an open running sore about three centimeters in diameter and surrounded by an area of erythema which was painless. Numerous subcutaneous nodules and palpable cord-like thickenings of the lymphatic vessels surrounded the ulcer. Laboratory examinations of exudate from the lesion revealed numerous Leishman-donovan bodies.

Other Theaters of Operation.--The Africa Middle East theater was the center of leishmaniasis for the United States Army. No less than 315 of the 344 cases for troops of the army as a whole occurred in that locality. The four that were noted in the European theater came from that endemic focus of the disease. Other than the China-Burma-India theater only scattered cases were observed elsewhere. (Table 8)



Table 1

## Malaria

## European Theater of Operations, U.S. Army

Cases and Rates per 1000 strength per annum, by months

February 1942 to June 1945, Inclusive

Month	Total		1942		1943		1944		1945	
	Cases	Rate	Cases	Rate	Cases	Rate	Cases	Rate	Cases	Rate
January	1234	4.60	0	-	3	.27	325	5.29	906	4.62
February	1302	4.57	0	-	3	.35	327	4.65	972	4.72
March	2971	7.88	0	-	0	-	760	7.36	2211	8.36
April	3399	10.51	0	-	0	-	1072	11.53	2327	10.63
May	4160	12.47	0	-	2	.21	1632	16.24	2526	11.40
June	3773	9.29	2	.56	8	.66	1517	11.93	2246	8.52
July	1921	14.29	1	.16	5	.26	1915	17.58		
August	1533	9.89	6	.68	3	.16	1524	12.01		
September	1022	5.12	4	.32	4	.17	1014	6.20		
October	825	4.29	5	.30	43	1.17	777	5.58		
November	951	4.65	1	.08	207	5.05	743	4.87		
December	1660	5.52	1	.11	392	6.03	1267	5.59		
Total	24751	7.78	20	.28	670	2.54	12873	8.74	11188	8.16

Source: Medical Statistics Division, Office of the Surgeon General, War Department,  
Washington, D. C.

Table 2

## Undiagnosed Fever

European Theater of Operations, U.S. Army

Cases and Rates per 1000 strength per annum, by months

February 1942 to June 1945, Inclusive

Month	Total		1942		1943		1944		1945	
	Cases	Rate	Cases	Rate	Cases	Rate	Cases	Rate	Cases	Rate
January	812	3.0			7	.6	31	.5	774	3.9
February	942	3.3	0	-	3	.4	27	.4	912	4.4
March	1716	4.6	0	-	11	1.3	155	1.5	1550	5.9
April	1914	5.9	0	-	7	.7	122	1.3	1785	8.2
May	2079	6.2	1	.5	2	.2	142	1.4	1934	8.7
June	1923	4.7	0	-	2	.2	292	2.3	1629	6.2
July	232	1.7	6	.9	8	.4	218	2.0		
August	646	4.2	5	.6	9	.5	632	5.0		
September	232	1.2	7	.6	4	.2	221	1.4		
October	192	1.0	13	.8	11	.3	168	1.2		
November	230	1.1	16	1.4	21	.5	193	1.3		
December	955	3.2	3	.3	83	1.3	869	3.8		
Total	11873	3.7	51	.7	168	.6	3070	2.1	8584	6.3

Source: Division of Medical Statistics, Office of the Surgeon General, War Department, Washington, D. C.

Table 3

## Malaria and Undiagnosed Fever

## United Kingdom and Continent

## European Theater of Operations, U.S. Army

Cases and Rates per 1000 strength per annum by months

September 1944 to June 1945, Inclusive

Month	Malaria						Undiagnosed Fever					
	Total			Continent			Total			United Kingdom		
	Cases	Rate	United Kingdom	Cases	Rate	Continent	Cases	Rate	Continent	Cases	Rate	Continent
1944												
September	1014	6.20	536	478	4.9		221	1.4		64	.97	157
October	777	5.58	232	545	5.6		168	1.2		33	.79	135
November	743	4.87	178	565	5.1		193	1.3		20	.49	173
December	1267	5.59	140	1127	6.8		869	3.8		46	.77	823
1945												
January	906	4.62	93	813	5.5		774	3.9		31	.63	743
February	972	4.72	60	912	5.7		912	4.4		21	.44	891
March	2211	8.36	69	2142	10.0		1550	5.9		39	.77	1511
April	2327	10.63	74	2253	12.4		1785	8.2		36	.93	1749
May	2526	11.40	68	2458	12.8		1934	8.7		18	.60	1916
June	2246	8.52	61	2185	10.1		1629	6.2		*		*
Total	14989	7.30	1511	13478	8.5		10035	4.9		308	.73	8098
												5.94

\* Data not available

Source: Division of Medical Statistics, Office of The Surgeon General, War Department, Washington, D. C.



Table 4

## Malaria in the Seventh U.S. Army (a)

## European Theater of Operations, U.S. Army

Cases and Rates per 1000 strength per annum, by weeks

Week ending 18 August 1944 to Week ending 29 June 1945, Inclusive

Week Ending		Cases	Rates based on Army strength	Rates based on strength of ori- ginal MTO contin- gent
1944 - August	18	97	44.3	
	25	616	273.0	
	September	1	433	174.7
		8	410	163.4
	15	333	141.0	
	22	326	143.4	
	29	301	116.2	
	October	6	260	111.2
		13	223	95.7
		20	247	104.1
	27	265	117.4	
	November	3	172	77.7
		10	145	57.6
1944 - December	17	165	58.3	61.76 (b)
	24	47	13.6	70.28
	1	40	10.3	20.02
	8	53	13.5	17.04
	15	43	10.9	22.57
	22	33	8.0	18.31
	29	47	11.2	14.06
	1945 - January	5	42	20.02
		12	43	17.89
		19	41	18.31
	26	46	8.7	17.46
	February	2	58	19.59
		9	68	24.70
		16	73	28.96
		23	73	31.09
		30	85	36.20

Table 4 (Cont'd)

## Malaria in the Seventh U.S. Army

## European Theater of Operations, U.S. Army

Cases and Rates per 1000 strength per annum, by weeks

Week ending 18 August 1944 to Week ending 29 June 1945, Inclusive

Week Ending		Cases	Rates based on Army strength	Rates based on strength of original MTO contingent
1945 - March	2	96	18.0	40.89
	9	136	26.3	59.93
	16	203	33.9	86.46
	23	120	20.0	51.11
	30	207	34.5	88.17
April	6	175	31.1	74.54
	13	191	34.5	81.35
	20	242	43.6	103.07
	27	199	34.6	84.76
May	4	369	65.0	157.17
	11	313	48.9	133.31
	18	400	66.1	170.37
	25	372	60.6	158.44
	31	308	51.2	131.18
June	8	255	32.8	108.61
	15	71 (c)	6.0	30.24
	22	36	3.8	15.33
	29	42	4.6	17.89
Total		8447	38.8	78.21

- (a) Troops of Seventh Army landed in Southern France 15 August 1944.  
 (b) First additions to troop strength from non-MTO sources  
 (c) 3rd and 45th Infantry no longer shown in Army reports. The 2d Armored Division was added.

Source: Division of Medical Statistics, Office of The Surgeon General, War Department, Washington, D. C.

Table 5

## Malaria

Total Army, Continental United States and

Theaters of Operations, U.S. Army

Cases and Rates per 1000 strength per annum

January 1942 to June 1945, Inclusive

Theater	Total		1942		1943		1944		1945	
	Cases	Rate	Cases	Rate	Cases	Rate	Cases	Rate	Cases	Rate
Total Army	423869	20.0	19067	6.2	160715	23.9	164165	21.9	79922	20.6
Continental U.S.	76829	5.9	1598	.6	8474	1.7	32292	8.1	34465	23.9
Total Overseas	347040	43.2	17469	34.	152241	96.	131873	38.0	45457	18.7
China-Burma-India	41545	125.0	941	16.5	8316	181.0	27777	174.	4511	37.3
South West Pacific	103393	85.7	3533	52.7	47834	245.1	29590	53.4	22436	57.6
Africa-Middle East	10365	79.5	780	136.	6537	123.0	2781	59.0	267	11.2
Pacific Ocean Area	81263	77.8	1780	12.1	61439	208.1	16955	43.0	1089	5.3
Mediterranean	69580	51.4	221	10.4	23076	53.5	40682	61.7	5601	23.3
Latin America	16073	46.1	10156	99.	4355	36.0	1206	14.0	356	9.1
European	24751	7.8	20	.3	670	2.5	12873	8.7	11188	8.2
North America	47	.3	25	.6	7	.1	9	.2	6	.4
Alaska	23	.1	13	.3	7	.1	0	.0	3	.1

Source: Division of Medical Statistics, Office of The Surgeon General, War Department, Washington, D. C.



Table 6

## Sand Fly Fever

Total Army, Continental United States and

Theaters of the U. S. Army, Cases and Rates per 1000 Strength per Annum

January 1942 to June 1945, Inclusive

Theater	Total		1942		1943		1944		1945	
	Cases	Rate	Cases	Rate	Cases	Rate	Cases	Rate	Cases	Rate
Total Army	10726	.51	310	.10	3332	.50	6189	.82	895	.23
Continental United States	0	0	0	-	0	0	0	0	0	0
Total Overseas	10726	1.33	310	.60	3332	2.09	6189	1.77	895	.37
African-Middle East	3357	25.75	287	50.02	2081	39.00	920	19.42	69	2.89
Mediterranean	4957	3.66	0	-	581	1.35	3753	5.69	623	2.59
China-Burma-India	2361	7.11	12	2.13	666	14.46	1492	9.35	191	1.58
Latin American Southwest	10	.03	4	.04	3	.02	3	.03	0	0
Pacific	30	.02	7	.10	1	.01	21	.04	1	.003
Pacific Ocean Area	4	.004	0	-	0	0	0	-	4	.02
European	7	.002	0	-	0	0	0	-	7	.01
North American	0	0	0	-	0	0	0	-	0	0
Alaskan	0	0	0	-	0	0	0	-	0	0

Source: Medical Statistics Division, Office of The Surgeon General, War Department, Washington, D. C.

Table 7

## Relapsing Fever

Total Army, Continental United States  
and Theaters of Operations, Number of Cases  
January 1942 to June 1945, Inclusive

Theater	Cases
Total Army	184
Continental United States	25
Overseas	159
China-Burma-India	91
Mediterranean	37
Africa-Middle East	22
European	2
Latin American	5
Southwest Pacific	2
Alaskan	0
North American	0
Pacific Ocean Area	0

Source: Medical Statistics Division, Office of  
The Surgeon General, War Department,  
Washington, D. C.

Table 8

Leishmaniasis

Total Army, Continental United States  
and Theaters of Operations, Number of Cases  
January 1942 to June 1945, Inclusive

Theater	Cases
Total Army	344
Continental United States	4
Overseas	340
Africa-Middle East	315
China-Burma-India	17
European	4
Mediterranean	3
Latin American	1
Alaskan	0
North American	0
Pacific Ocean Area	0
Southwest Pacific	0

Source: Medical Statistics Division, Office of  
The Surgeon General, War Department  
Washington, D. C.





## FIGURES

1. Distribution of indigenous malaria in Great Britain, during the 18th century and after the 1914-18 war.
2. Special study of recrudescence and relapse after primary malarial attack, First General Medical Laboratory, England, 1944.
3. Distribution of indigenous malaria in countries of Western Europe, showing areas of high and low indemicity.
4. Malaria in the 1st U. S. Infantry Division, North African and European Theaters of Operations, rates per 1000 strength per annum, by weeks, May 1943 to May 1945.
5. Malaria in the 2nd Armored Division, North African and European Theaters of Operations, rates per 1000 strength per annum, by weeks, January 1944 to June 1945.
6. Search for malaria vectors, Marseilles district, April 1945.





## TABLES

1. Malaria, European Theater of Operations, U. S. Army, Cases and Rates per 1000 strength per annum, by months, February 1942 to June 1945, inclusive.
2. Undiagnosed Fever, European Theater of Operations, U. S. Army, Cases and Rates per 1000 strength per annum, by months, February 1942 to June 1945, inclusive.
3. Malaria and Undiagnosed Fever, European Theater of Operations, U. S. Army, United Kingdom and Continental Europe, Cases and Rates per 1000 strength per annum, by months, September 1944 to June 1945, inclusive.
4. Malaria in the Seventh U. S. Army, European Theater of Operations, U. S. Army, Cases and Rates per 1000 strength per annum, by weeks, Week ending 18 August 1944 to week ending 29 June 1945, inclusive.
5. Malaria, Total Army, Continental United States and Theaters of Operations, U. S. Army, Cases and Rates per 1000 strength per annum, January 1942 to June 1945, inclusive.
6. Sand Fly Fever, Total Army, Continental United States and Theaters of Operations, Cases and Rates per 1000 strength per annum, January 1942 to June 1945, inclusive.
7. Relapsing Fever, Total Army, Continental United States and Theaters of Operations, Number of Cases, January 1942 to June 1945, inclusive.
8. Leishmaniasis, Total Army, Continental United States and Theaters of Operations, Number of Cases, January 1942 to June 1945, inclusive.



## EPIDEMIOLOGIC CASE REPORTS

1. Relapsing fever, occurring in Great Britain.
2. Leishmaniasis, visceral form.
3. Leishmaniasis, cutaneous form.





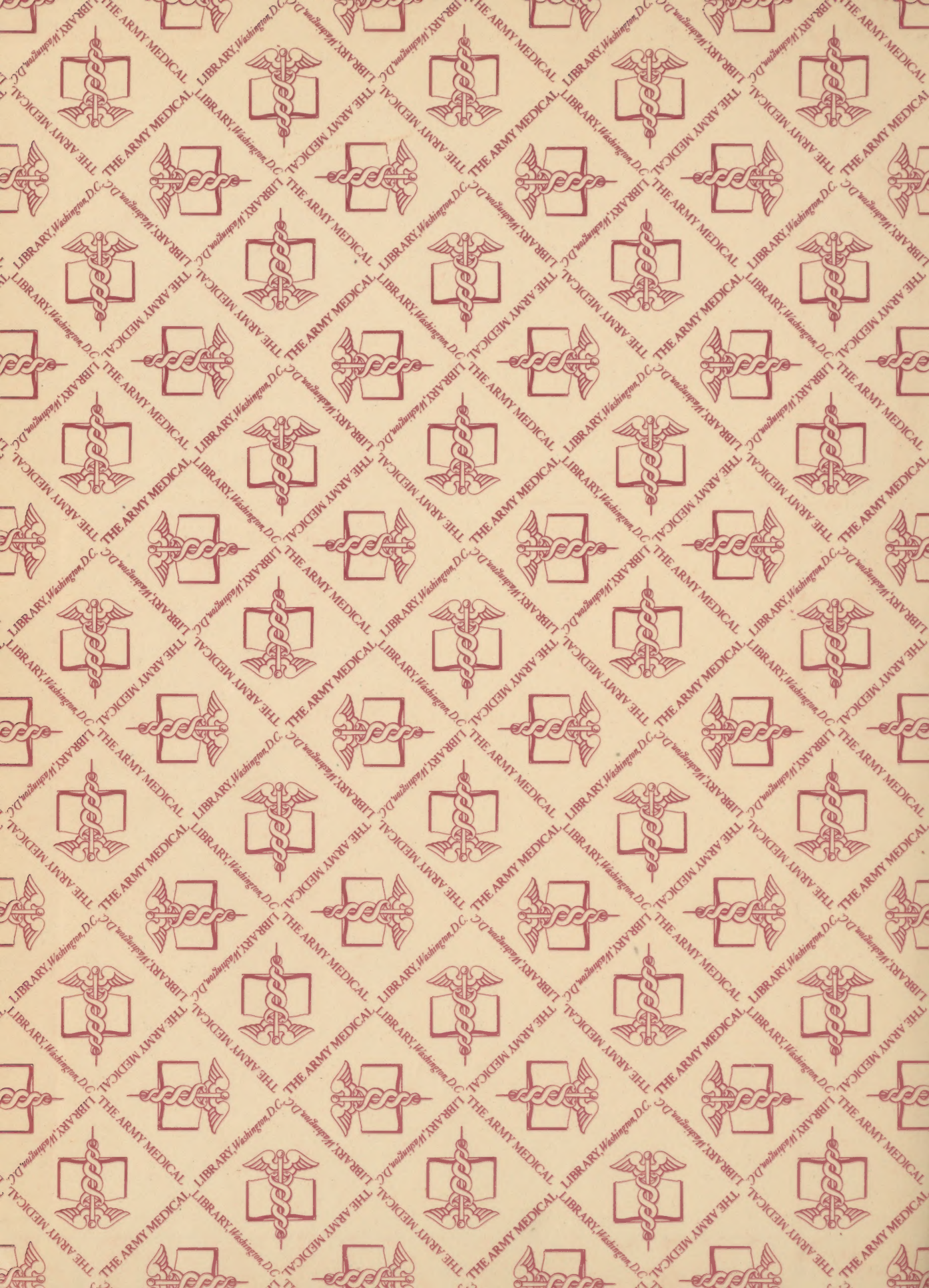




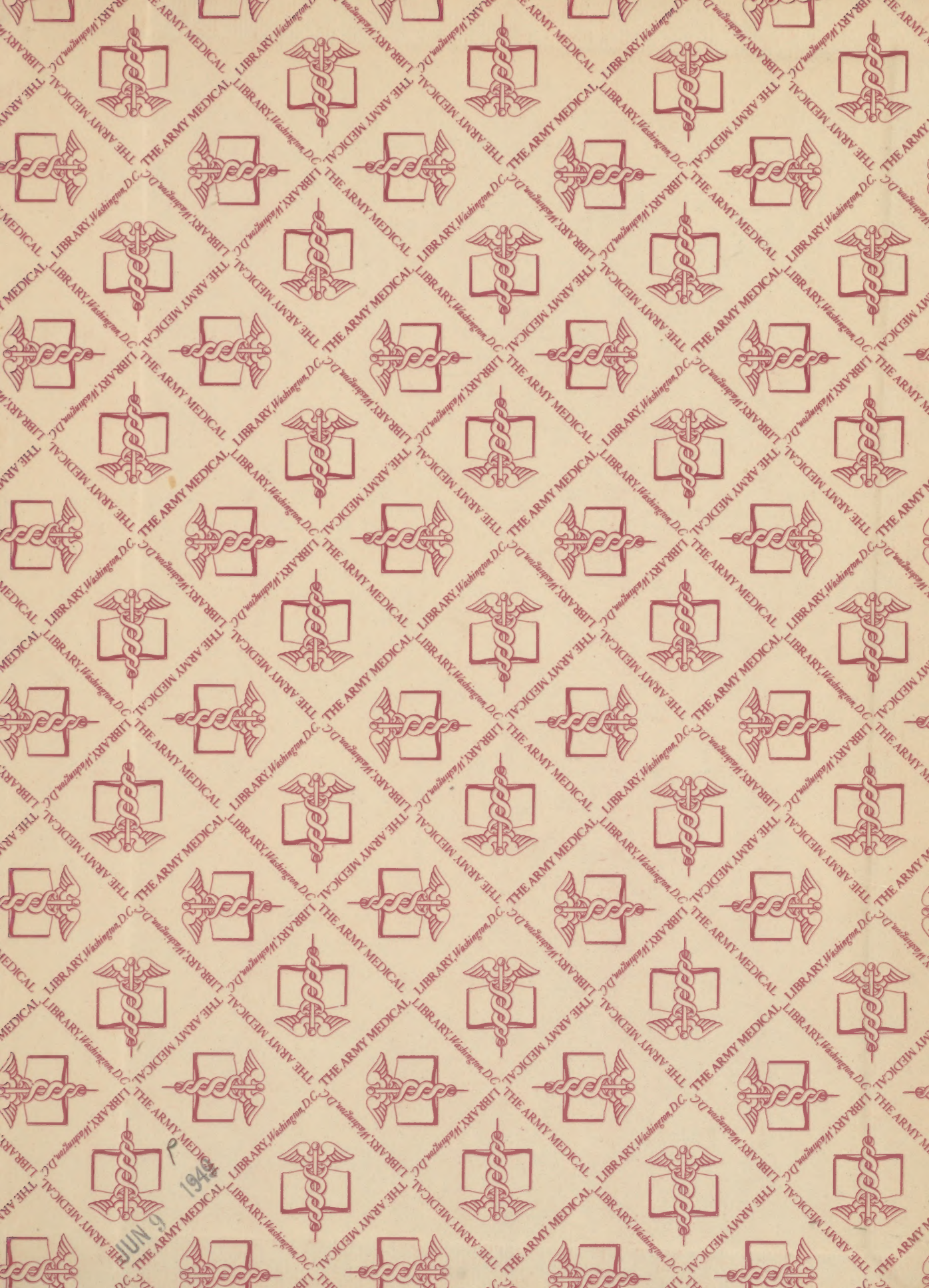












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